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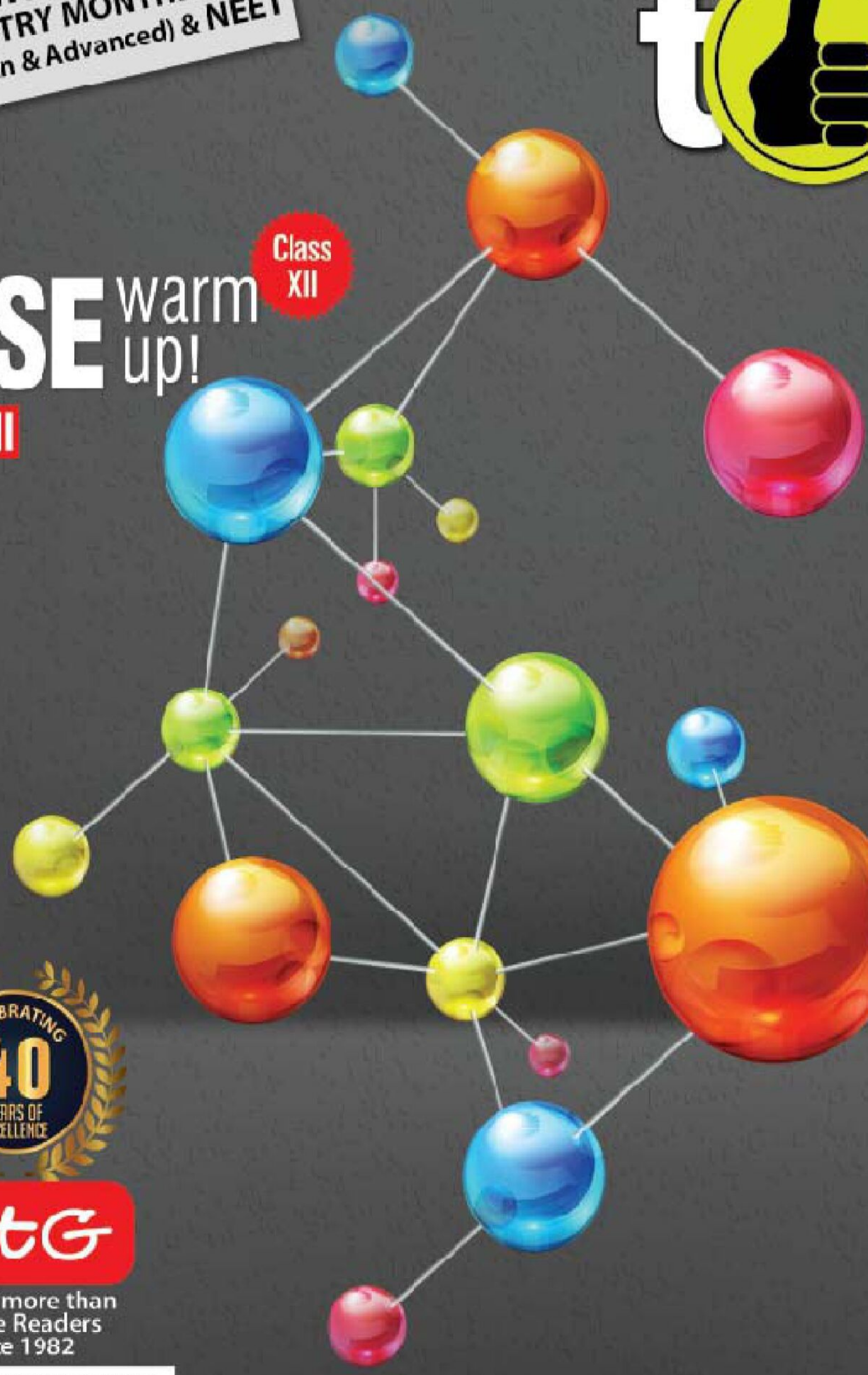

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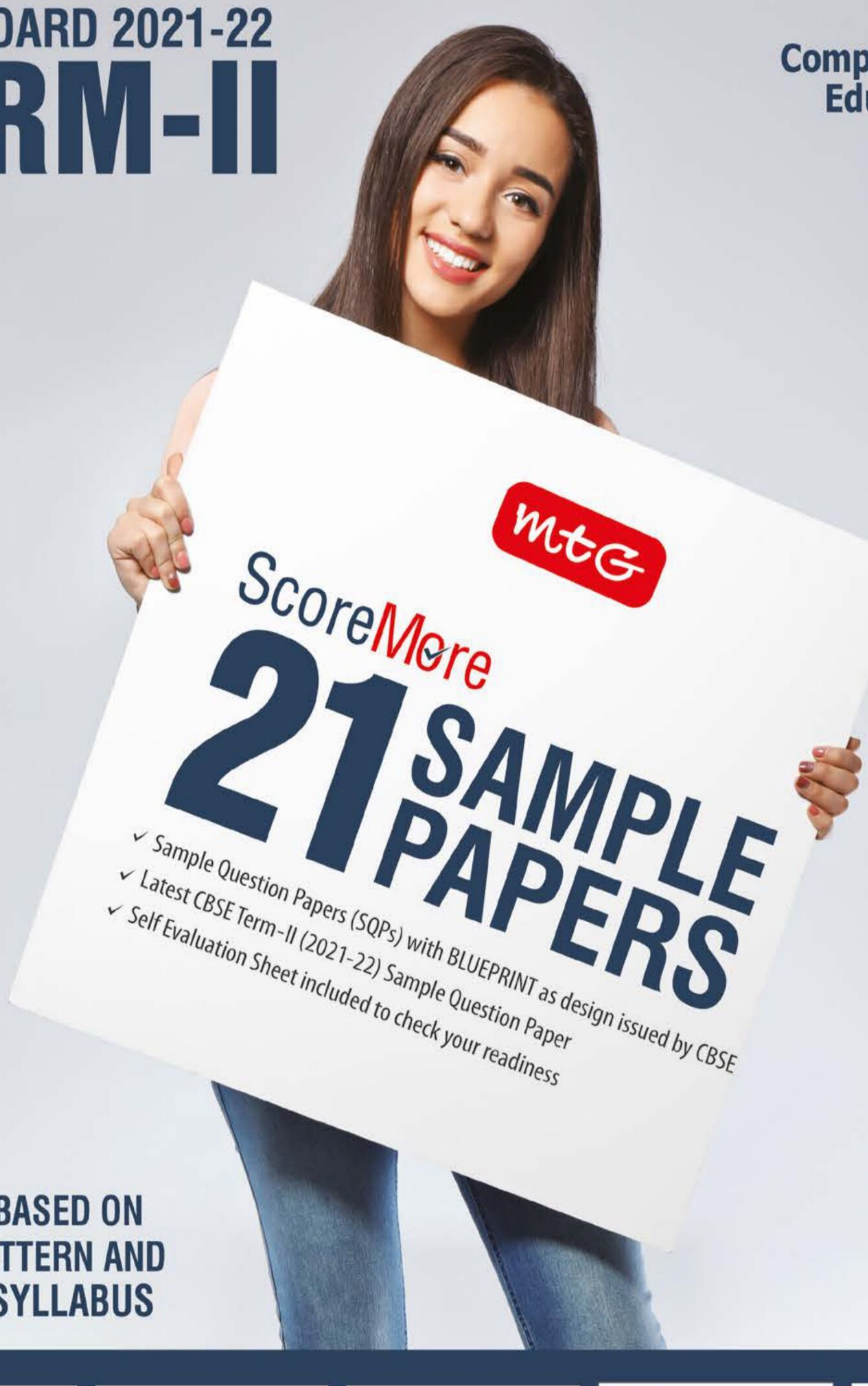

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It's advantage Mock Tests

Should one take more mock tests or utilise the time revising? This is a question that has often plagued JEE/NEET students' mind. Find out why taking mock tests is crucial for your preparation and success.

If you ask the students who have cleared JEE or NEET for a mantra, they are most likely to share their belief in the saying 'practice makes perfect'. A key factor to be JEE/NEET–ready is to take as many mock tests as possible. Don't let anyone tell you that time spent taking such tests is time away from studying or revising. In fact, it is quite the opposite. Mock tests are the single most important differentiator among students of the same preparation level.

Understand your preparation level

It is important to understand your overall level of preparation. Is your concept base solid? Can you recall the formulas easily? Are you able to timely solve questions based on simple concepts? Are you able to figure out the tricky questions? You need to have answers to questions like these much before the actual exam. Take your time to analyse how well you are prepared and take steps to rectify any weaknesses in your preparation or question solving strategies.

Test your subject–wise expertise

JEE Advanced has subject–wise cut–offs to secure admission in any of the colleges. NEET, on the other hand, has overall cut–off which is high, and you need to score a certain number of marks in each subject. Here, mock tests come to your rescue. Taking them helps you understand your proficiency in each subject. Amazon Academy mock test analytics provide subject–wise percentile so that you can understand how well prepared you are in each subject, apart from your overall preparation. This helps in refocusing on your weaker subjects so that you can work on them better.

Improve speed and accuracy

This point cannot be stressed hard enough. You need to constantly improve your speed and accuracy to perform better in JEE and NEET. Speed is a core element of both. For example, you have to answer 180 questions in 180 minutes in NEET, that is one minute per question on an average. This doesn't give you a lot of time to think leisurely. You need to solve questions fast, and accurately. There is no scope for silly mistakes. Accuracy is critical for JEE Advanced, which is known for complex and intricate questions. Here too, the more mock tests you have taken, the better prepared you are for solving questions fast under exam pressure.

Revise old topics

The most efficient technique for revision is practice. Mock tests are the perfect platform for you to revise what you have learnt. When you solve questions of a topic that you studied a few days or months back, all your learning and retention is brought to test. You can clearly understand how much you know and what you need to brush up. The clarity of your concepts is also tested. Plus, regularly solving questions of previous topics keeps them fresh and top of mind. It reduces the chances of error in the real exam significantly.

Most full–term courses of JEE and NEET come with test series. If you haven't enrolled in one, you can also sign up for Test Series separately. Amazon Academy has launched an excellent Mock Test Series for both JEE and NEET that you can enrol in to boost your exam preparation. They also give you access to the Live Test Analysis sessions where you can learn about the optimum question solving tricks from expert Amazon Academy faculty. Irrespective of whatever you choose, keep up the practice.

Disclaimer: The information provided in this article is of a general nature and should not be considered a substitute for professional advice.

CHEMISTRY today

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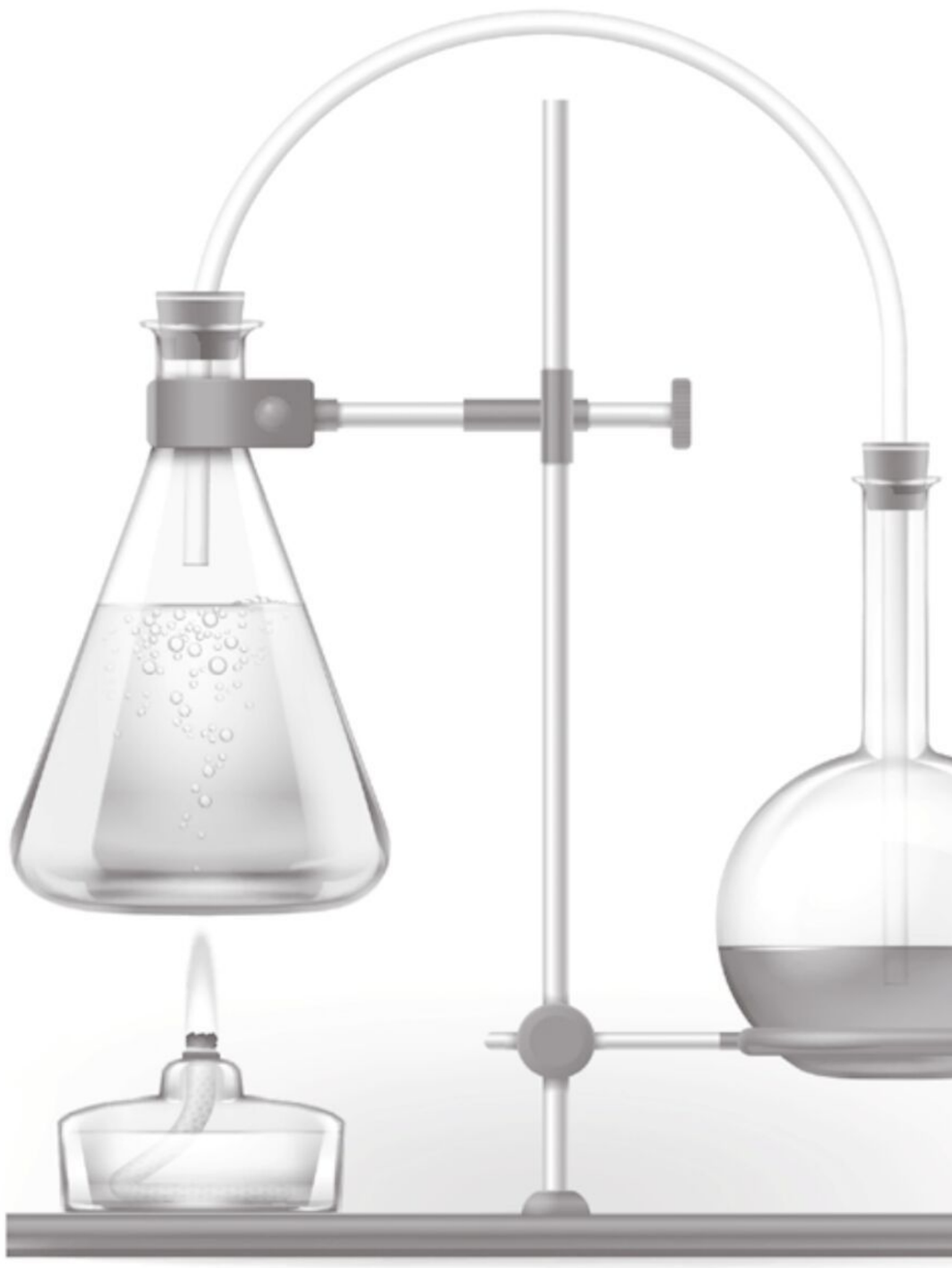

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Editor : Anil Ahlawat

GET SET GO for NEET

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Practicing these MCQs help to strengthen your concepts and give you extra edge in your NEET preparation

1. In which of the following, central atom is sp^3 hybridised?
(a) CH_3^+ (b) NH_4^+ (c) NO_2^+ (d) CO_3^{2-}

2. In the given reaction,
$R-C\equiv C-CH=CH_2 \xrightarrow{HCO_3H} Z$
The product Z may be
(a) $R-\underset{OH}{C}=\underset{OH}{C}-\underset{OH}{CH}-\underset{OH}{CH_2}$
(b) $R-CH=CH-CH_2-CH_2-OH$
(c) $R-C\equiv C-\underset{OH}{CH}-\underset{OH}{CH_2}$
(d) $R-\underset{OH}{CH}-\underset{OH}{CH}-CH=CH_2$

3. Which of the following statements are wrong?
1. Barium is more reducing than magnesium.
2. $Ba(OH)_2$ is more basic than $Be(OH)_2$.
3. Mg^{2+} ions are precipitated as $MgCO_3$ by ammonium carbonate in presence of ammonium chloride.
4. $MgCl_2$ gives colouration in flame test.
(a) 1 and 2 (b) 3 and 4
(c) 1 and 3 (d) 1, 2 and 3

4. The position of both, an electron and a helium atom is known within 1.0 nm. Further the momentum of the electron is known within 5.0×10^{-26} kg m s^{-1}. The minimum uncertainty in the measurement of the momentum of the helium atom is
(a) 8.0×10^{-26} kg m s^{-1} (b) 80 kg m s^{-1}
(c) 50 kg m s^{-1} (d) 5.0×10^{-26} kg m s^{-1}

5. A substance which participates readily in both acid-base and oxidation-reduction reactions is
(a) Na_2CO_3 (b) KOH
(c) $KMnO_4$ (d) $H_2C_2O_4$

6. Two oxides of a certain metal were separately heated in a current of hydrogen until constant weights were obtained. The water produced in each case was carefully collected and weighed. 2 g of each oxide gave respectively 0.2517 g and 0.4526 g of water. This observation illustrates
(a) law of conservation of mass
(b) law of constant proportions
(c) law of multiple proportions
(d) law of reciprocal proportions.

7. Which of the following is the correct order of Lewis acid strength of BF_3, BCl_3 and BBr_3?
(a) $BF_3 > BCl_3 > BBr_3$ (b) $BF_3 = BCl_3 = BBr_3$
(c) $BF_3 < BCl_3 < BBr_3$ (d) $BBr_3 > BF_3 > BCl_3$

8. The ionization constant of an acid-base indicator (a weak acid) is 1.0×10^{-6}. The ionized form of the indicator is red whereas the unionized form is blue. The pH change required to alter the colour of the indicator from 80% blue to 80% red is

(a) 2.00 (b) 1.40 (c) 1.20 (d) 0.80

9. Match List I with List II and select the correct answer using the codes given below the lists :

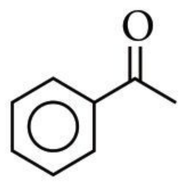
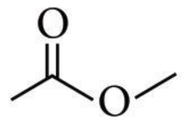
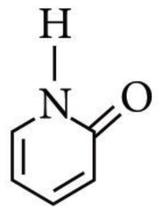
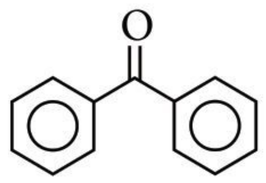
	List I (Pollutant)		**List II (Source)**
(A)	Microorganisms	1.	Chemical fertilizers
(B)	Plant nutrients	2.	Abandoned coal mines
(C)	Sediments	3.	Domestic sewage
(D)	Mineral acids	4.	Erosion of soil by strip mining
		5.	Detergents

	A	**B**	**C**	**D**
(a)	3	1	4	2
(b)	2	5	3	1
(c)	1	3	2	4
(d)	4	2	1	5

10. The r.m.s. velocity of hydrogen is $\sqrt{7}$ times the r.m.s. velocity of nitrogen. If T is temperature of the gas, then

(a) $T(H_2) = T(N_2)$ (b) $T(H_2) > T(N_2)$
(c) $T(H_2) < T(N_2)$ (d) cannot be predicted.

11. Which of the following will not show tautomerism?

(a) 
(b) 
(c) 
(d) 

12. Elements A, B, C, D and E have the following electronic configuration :

(A) $1s^2\,2s^2\,2p^2$ (B) $1s^2\,2s^2\,2p^6\,3s^2$
(C) $1s^2\,2s^2\,2p^5$ (D) $1s^2\,2s^2\,2p^6\,3s^2\,3p^2$
(E) $1s^2\,2s^2\,2p^6\,3s^2\,3p^6$

Which of these will belong to the same group in the periodic table?

(a) A and B (b) A and C
(c) A and D (d) A and E

13. The ΔH for the formation of $NOCl_{(g)}$ from the gaseous elements is 51.71 kJ mol^{-1} at 25°C. If the gases are ideal, calculate ΔU.

(a) $\Delta U = 75$ kJ mol^{-1}
(b) $\Delta U = 90$ kJ mol^{-1}
(c) $\Delta U = 55.65$ kJ mol^{-1}
(d) $\Delta U = 52.95$ kJ mol^{-1}

14. Hydrogen is not obtained when zinc reacts with

(a) dil. H_2SO_4 (b) dil. HCl
(c) cold water (d) hot NaOH (20%).

15. Structural formula of 2-ethoxy-4-methoxy-3-pentanone will be

(a) $CH_3-CH(OCH_3)-CO-\underset{\displaystyle C_2H_5}{\underset{|}{CH}}-OCH_3$

(b) $CH_3-CH(OC_2H_5)-CO-\underset{\displaystyle CH_3}{\underset{|}{CH}}-OCH_3$

(c) $CH_3-CH(OCH_3)-CO-\underset{\displaystyle CH_3}{\underset{|}{CH}}-OC_2H_5$

(d) $C_2H_3-\underset{\displaystyle OC_2H_5}{\underset{|}{CH}}-OC-\underset{\displaystyle OC_2H_5}{\underset{|}{CH}}-OCH_3$

SOLUTIONS

1. (b): NH_4^+, $V = 5$, $M = 4$, $C = 1$, $A = 0$

$H = \frac{1}{2}[5+4-1+0] = 4$, sp^3 hybridization

2. (c): Oxyformic acid hydroxylates double bond only and triple bond is not affected.

3. (b): Statements (3) and (4) are wrong.

$MgCO_3$ is prepared by adding sodium bicarbonate to a hot solution of magnesium salt like $MgSO_4$.

$MgSO_4 + 2NaHCO_3 \longrightarrow MgCO_3 + Na_2SO_4 + H_2O + CO_2$

Mg salts do not impart any colour to the flame as due to very small size, the electrons are held tightly and hence their excitation is difficult.

Statements (1) and (2) are correct.

Oxidation potential of Ba is 2.92 V and that of Mg is 2.36 V *i.e.* Ba is a better reducing agent than Mg.

$Be(OH)_2$ is amphoteric in nature but $Ba(OH)_2$ is basic as basicity of hydroxides increases with increasing electropositive character.

4. (d): According to uncertainty principle, the product of uncertainty in position and uncertainty in momentum is constant for a particle. *i.e.*, $\Delta x \times \Delta p = \frac{h}{4\pi}$

As, $\Delta x = 1.0$ nm for both electron and helium atom, so Δp is also same for both the particles.

Thus, uncertainty in momentum of the helium atom is also 5.0×10^{-26} kg m s^{-1}.

5. (d) : $H_2C_2O_4$ readily participates in oxidation-reduction and acid-base reactions both.

6. (c) : Weight of H_2O from oxides give weight of oxygen and metal in oxide.

$$0.2517 \text{ g } H_2O \text{ contains oxygen} = \frac{16}{18} \times 0.2517 = 0.2237 \text{ g}$$

Mass of metal = 2 – 0.2237 = 1.7763 g

$$0.4526 \text{ g } H_2O \text{ contains oxygen} = \frac{16}{18} \times 0.4526 = 0.4023 \text{ g}$$

Mass of metal = 2 – 0.4023 = 1.5977 g

Thus, we can get the weight of oxygen with constant weight of metal (1 g) for other oxides, which two are in simple ratio of 0.12 : 0.25 = 1 : 2

7. (c) : BF_3 is the weakest Lewis acid because it is less electron deficient due to back donation or back bonding of electron from F atom.

As a result of back donation of electron from fluorine to boron, the electron deficiency of boron is reduced and Lewis acid character is decreased. The tendency for the back bonding ($p\pi$-$p\pi$ bonds) is maximum in BF_3 and decreases rapidly from BF_3 to BI_3.

8. (c) : $HIn \rightleftharpoons H^+ + In^-$; $pH = pK_{In} + \log \frac{[In^-]}{[HIn]}$

$$(pH)_1 = pK_{In} + \log \frac{20}{80} = pK_{In} - 2\log 2$$

$$(pH)_2 = pK_{In} + \log \frac{80}{20} = pK_{In} + 2\log 2$$

Hence, $(pH)_2 - (pH)_1 = pK_{In} + 2\log 2 - (pK_{In} - 2\log 2)$

$$= 4\log 2 = 1.20$$

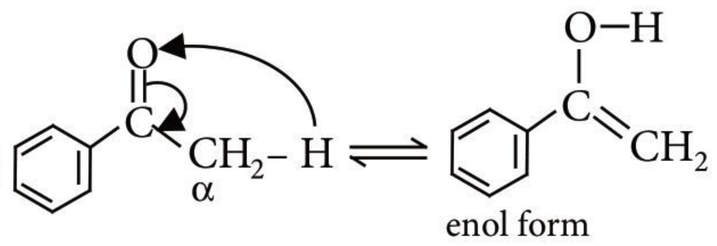
9. (a) : Chemical fertilizers are source of plant nutrients, coal mines are source of mineral acids, domestic sewage is a rich source of microorganisms and erosion of soil by strip mining yield sediments.

10. (c) : $C_{rms} = \sqrt{\frac{3RT}{M}}$

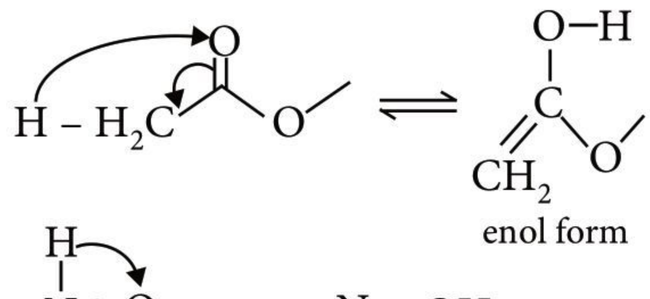
$$\frac{C_{rms}(H_2)}{C_{rms}(N_2)} = \sqrt{\frac{T(H_2)}{M(H_2)} \times \frac{M(N_2)}{T(N_2)}}$$

$$\sqrt{7} = \sqrt{\frac{T(H_2)}{T(N_2)} \times \frac{28}{2}} \text{ or } \frac{T(H_2)}{T(N_2)} = \frac{1}{2}$$

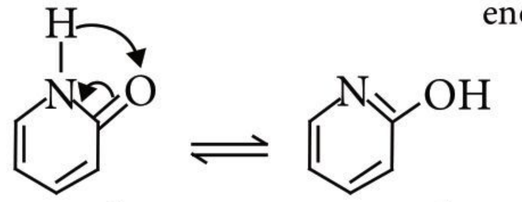
11. (d): (a)



(b)



(c)



(d) does not show tautomerism because α-H is absent.

12. (c) : *A* and *D* belongs to same group because in same group, number of valence electrons are same.

A : $1s^2\ 2s^2\ 2p^2$

D : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$

13. (d) : From the reaction,

$$\frac{1}{2}N_{2(g)} + \frac{1}{2}O_{2(g)} + \frac{1}{2}Cl_{2(g)} \rightarrow NOCl_{(g)},$$

$\Delta H = 51.71$ kJ

$\Delta U = \Delta H - \Delta(PV) = \Delta H - \Delta n_g RT$

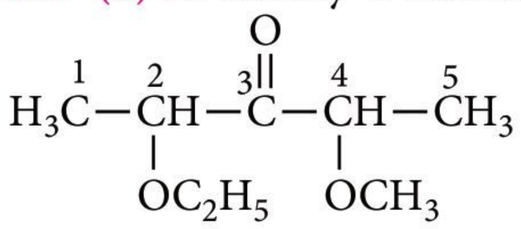
$$\left[\Delta n_g = 1 - \frac{1}{2} - \frac{1}{2} - \frac{1}{2} = -\frac{1}{2} \text{ mol}\right]$$

$$= 51.71 \text{ kJ} - (8.314 \times 10^{-3} \text{ kJK}^{-1} \text{ mol}^{-1})(298 \text{ K})\left(-\frac{1}{2} \text{ mol}\right)$$

or $\Delta U = 52.95$ kJ.

14. (c) : Zinc has no action on cold water.

15. (b) : 2-Ethoxy-4-methoxy-3-pentanone,



Ethoxy is given more priority over methoxy as per alphabetic order.

MONTHLY TEST DRIVE CLASS XII ANSWER KEY

1.	(a)	**2.**	(b)	**3.**	(a)	**4.**	(c)	**5.**	(b)
6.	(c)	**7.**	(c)	**8.**	(a)	**9.**	(d)	**10.**	(c)
11.	(d)	**12.**	(b)	**13.**	(c)	**14.**	(a)	**15.**	(c)
16.	(a)	**17.**	(b)	**18.**	(d)	**19.**	(c)	**20.**	(c,d)
21.	(a,d)	**22.**	(a,c)	**23.**	(b,c,d)	**24.**	(71.47)		
25.	(2)	**26.**	(1)	**27.**	(b)	**28.**	(c)	**29.**	(d)
30.	(b)								

MONTHLY TEST DRIVE

Practice Paper

XI

This specially designed column enables students to self analyse their extent of understanding complete syllabus. Give yourself four marks for correct answer and deduct one mark for wrong answer. Self check table given at the end will help you to check your readiness.

Total Marks : 120 **Time Taken : 60 Min.**

NEET

Only One Option Correct Type

1. The value of van der Waals' constant '*a*' for the gases O_2, N_2, NH_3 and CH_4 are 1.360, 1.390, 4.170 and 2.253 L^2 atm mol^{-2} respectively. The gas which can most easily be liquefied is
(a) O_2 (b) N_2
(c) NH_3 (d) CH_4

2. The number of radial nodes of 3*s* and 2*p* orbitals are respectively
(a) 2, 0 (b) 0, 2
(c) 1, 2 (d) 2, 1

3. According to Fajan's rule, covalent bond is favoured by
(a) large cation and small anion
(b) large cation and large anion
(c) small cation and small anion
(d) small cation and large anion.

4. Which of the following order is wrong?
(a) $NH_3 < PH_3 < AsH_3$ - acidic
(b) Li < Be < B < C - 1^{st} ionisation potential
(c) $Al_2O_3 < MgO < Na_2O < K_2O$ - basicity
(d) $Li^+ < Na^+ < K^+ < Cs^+$ - ionic radius

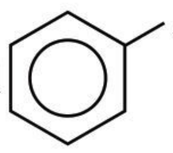
5. For melting of a solid at 25°C, the fusion process requires energy equivalent to 2906 Joules to be added to system considering the process to be reversible at fusion point, the entropy change of the process is
(a) 9.75 J K^{-1} mol^{-1} (b) 11.272 J K^{-1} mol^{-1}
(c) 2.33 J K^{-1} mol^{-1} (d) insufficient data.

6. The correct order of increasing basicity of the given conjugate bases (where $R = CH_3$) is
(a) $RCOO^- < HC\equiv C^- < NH_2^- < R^-$
(b) $RCOO^- < HC\equiv C^- < R^- < NH_2^-$
(c) $R^- < HC\equiv C^- < RCOO^- < NH_2^-$
(d) $RCOO^- < NH_2^- < HC\equiv C^- < R^-$

7. The hybridization of oxygen atom in H_2O_2 is
(a) sp^3d (b) sp
(c) sp^2 (d) sp^3

8. The correct order of the solubility of sulphates of alkaline earth metals in water is
(a) Be > Ca > Mg > Ba > Sr
(b) Mg > Be > Ba > Ca > Sr
(c) Be > Mg > Ca > Sr > Ba
(d) Mg > Ca > Ba > Be > Sr.

9. The oxide which cannot act as reducing agent is
(a) SO_2 (b) NO_2 (c) CO_2 (d) ClO_2

10. In a compound 

electrophilic substitution has occured. The substituent-*E* are methyl, $-CH_2Cl$, $-CCl_3$ and $-CHCl_2$. The correct increasing order towards electrophilic substitution is
(a) $-CH_3 < -CH_2Cl < -CHCl_2 < -CCl_3$
(b) $-CH_3 < -CHCl_2 < -CH_2Cl < -CCl_3$
(c) $-CCl_3 < -CH_2Cl < -CHCl_2 < -CH_3$
(d) $-CCl_3 < -CHCl_2 < -CH_2Cl < -CH_3$

11. Identify '*Z*' in the following reactions sequence:

$$CH_3CH_2CH_2OH \xrightarrow[160\text{-}180^\circ C]{\text{conc. } H_2SO_4} X \xrightarrow{Br_2} Y \xrightarrow[\text{(ii) } NaNH_2]{\text{(i) alc. KOH}} Z$$

(a) $CH_3 - CH(NH_2) - CH_2NH_2$
(b) $CH_3 - CH(OH) - CH_2OH$
(c) $CH_3 - C(OH)=CH_2$
(d) $CH_3 - C\equiv CH$

12. BOD values of four sample of water *A*, *B*, *C* and *D* is given below :

A. 160 ppm *B*. 35 ppm
C. 180 ppm *D*. 25 ppm

The decreasing order of extent of pollution in water is

(a) $C > A > D > B$
(b) $D > B > A > C$
(c) $C > A > B > D$
(d) $D > A > B > C$

Assertion & Reason Type

Directions : In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as :

(a) If both assertion and reason are true and reason is the correct explanation of assertion.
(b) If both assertion and reason are true but reason is not the correct explanation of assertion.
(c) If assertion is true but reason is false.
(d) If both assertion and reason are false.

13. **Assertion :** The Dumas method is more applicable to nitrogen containing organic compounds than the Kjeldahl's method.
Reason : The Kjeldahl's method does not give satisfactory results for compounds in which nitrogen is directly linked to oxygen.

14. **Assertion :** Pb_3O_4 reacts with HNO_3 and forms PbO_2.
Reason : Lead is stable in +4 oxidation state.

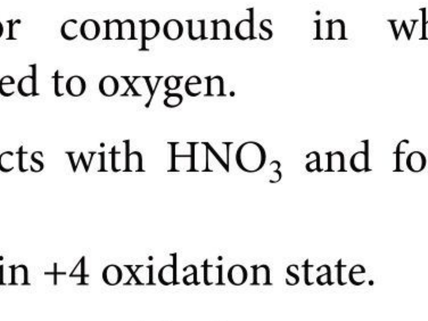
15. **Assertion :** Oxidation state of hydrogen is +1 in H_2O while –1 in CaH_2.
Reason : CaH_2 is a metal hydride and for hydrides, hydrogen is assigned the oxidation number of –1.

JEE MAIN / JEE ADVANCED

Only One Option Correct Type

16. For the given *PV* isotherms, which of the following is correct for T_1, T_2, T_3?

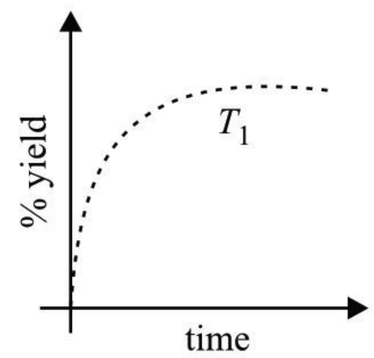
(a) $T_1 < T_2 < T_3$
(b) $T_3 < T_2 < T_1$
(c) $T_2 < T_3 < T_1$
(d) $T_1 < T_3 < T_2$



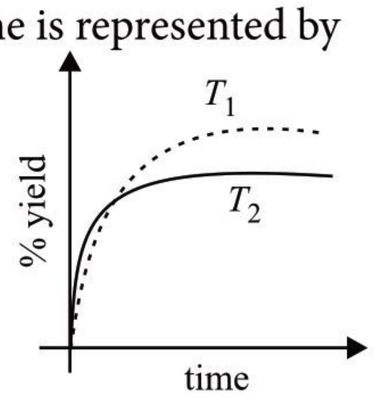
17. The gas leaked from a storage tank of the Union Carbide plant in Bhopal gas tragedy was

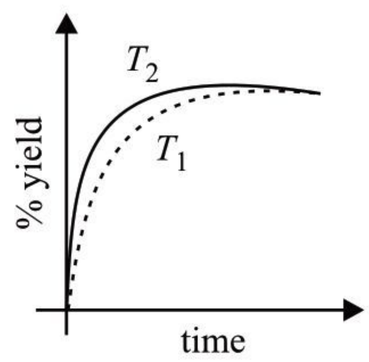
(a) phosgene (b) methylisocyanate
(c) methylamine (d) ammonia.

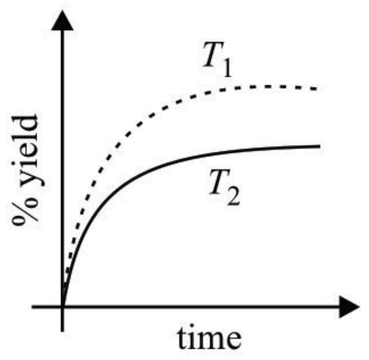
18. The % yield of product of given reaction as a function of time

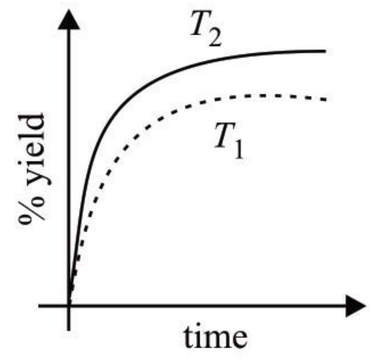


$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)} + \Delta H$ at (P, T_1) is given below. If this reaction is conducted at (P, T_2), with $T_2 > T_1$, the % yield of ammonia as a function of time is represented by

(a)


(b)


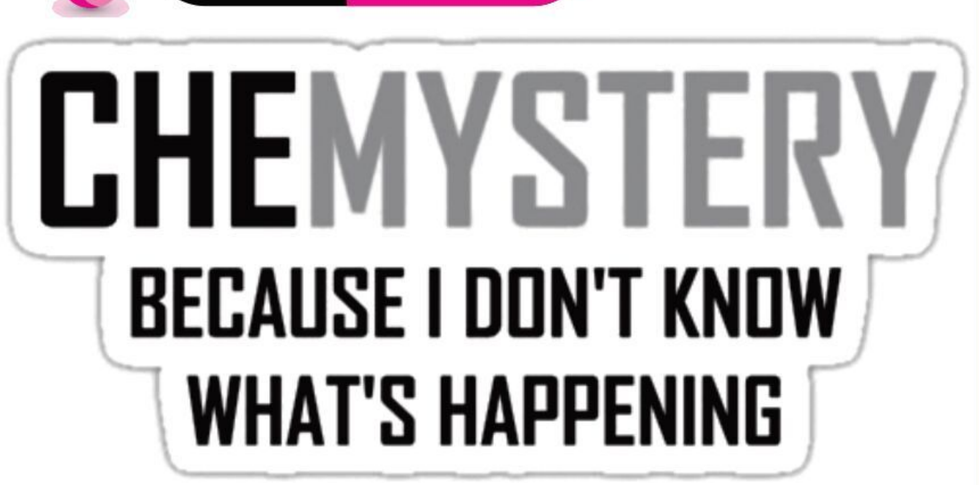
(c)


(d)


19. A group 13 element '*X*' reacts with chlorine gas to produce a compound XCl_3. XCl_3 is electron deficient and easily reacts with NH_3 to form $Cl_3X \leftarrow NH_3$ adduct; however, XCl_3 does not dimerize. *X* is

(a) Ga (b) Al
(c) In (d) B.

COMIC CAPSULE



More Than One Options Correct Type

20. In the electrolysis of alumina, cryolite is added to
(a) lower the melting point of alumina
(b) increase the electrical conductivity
(c) minimise the anode effect
(d) remove impurities from alumina.

21. Hydrogen bonding plays a central role in which of the following phenomena?
(a) Ice floats in water.
(b) Higher Lewis basicity of primary amines than tertiary amines in aqueous solutions.
(c) Formic acid is more acidic than acetic acid.
(d) Dimerisation of acetic acid in benzene.

22. The option(s) with only amphoteric oxides is(are)
(a) Cr_2O_3, BeO, SnO, SnO_2
(b) ZnO, Al_2O_3, PbO, PbO_2
(c) NO, B_2O_3, PbO, SnO_2
(d) Cr_2O_3, CrO, SnO, PbO

23. A gas described by van der Waals' equation
(a) behaves similar to an ideal gas in the limit of large molar volumes
(b) behaves similar to an ideal gas in the limit of large pressures
(c) is characterised by van der Waals' coefficients that are dependent on identity of the gas but are independent of the temperature
(d) has the pressure that is lower than the pressure exerted by the same behaving ideally.

Integer / Numerical Value Type

24. By using the given data,

Substance	$\Delta H°$ (kJ mol^{-1})	$\Delta S°$ (J mol^{-1} K^{-1})
$FeO_{(s)}$	–266.3	57.49
$C_{(graphite)}$	0	5.74
$Fe_{(s)}$	0	27.28
$CO_{(g)}$	–110.5	197.6

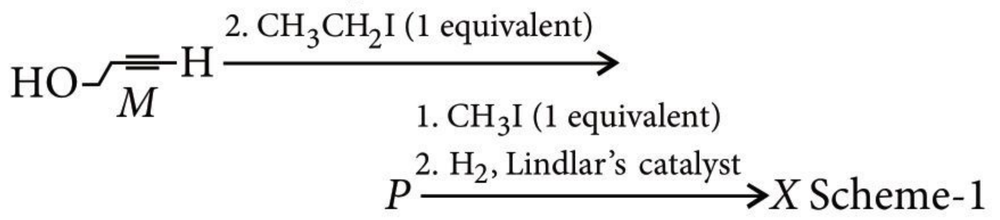
calculate the minimum temperature in K at which the reduction of FeO by graphite becomes spontaneous.

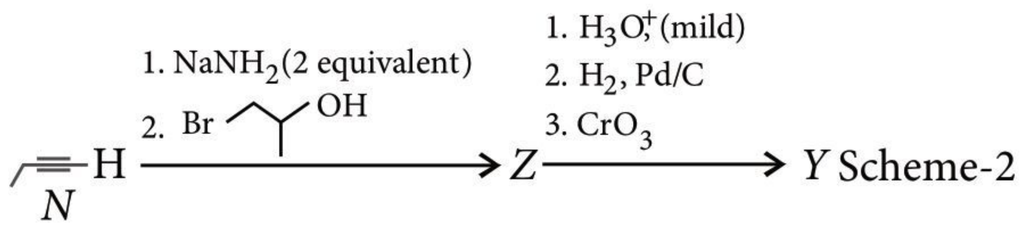
25. The atomic masses of He and Ne are 4 and 20 a.m.u., respectively. The value of the de Broglie wavelength of He gas at –73°C is M times that of the de Broglie wavelength of Ne at 727°C. M is _____.

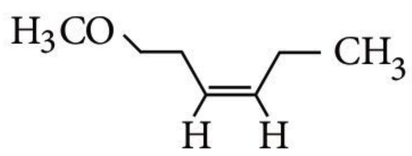
26. The total number of cyclic structural as well as stereoisomers possible for a compound with the molecular formula, C_5H_{10} is _____.

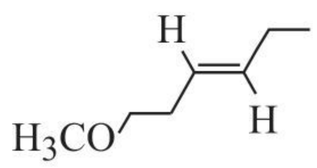
Comprehension Type

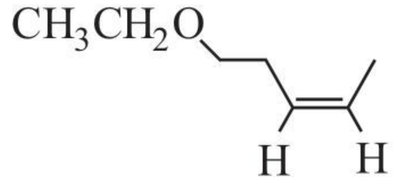
Schemes 1 and 2 describe sequential transformation of alkynes M and N. Consider only the major products formed in each step for both the schemes.

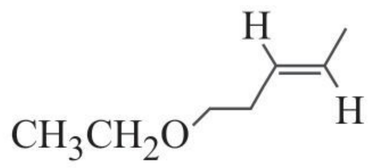




27. The product 'X' is
(a) 

(b) 

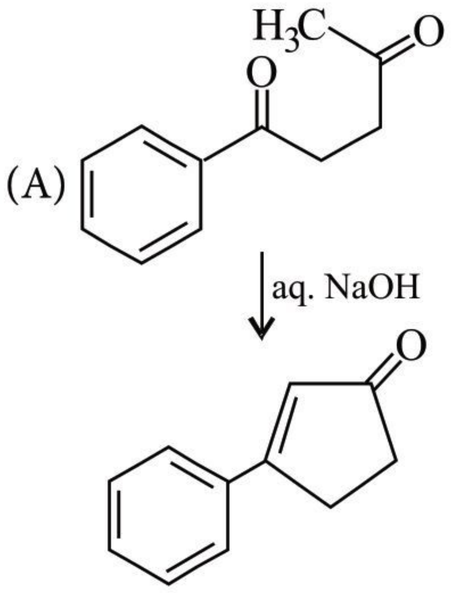
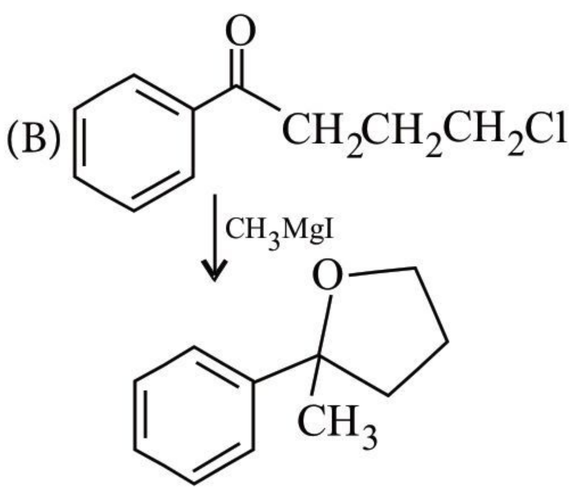
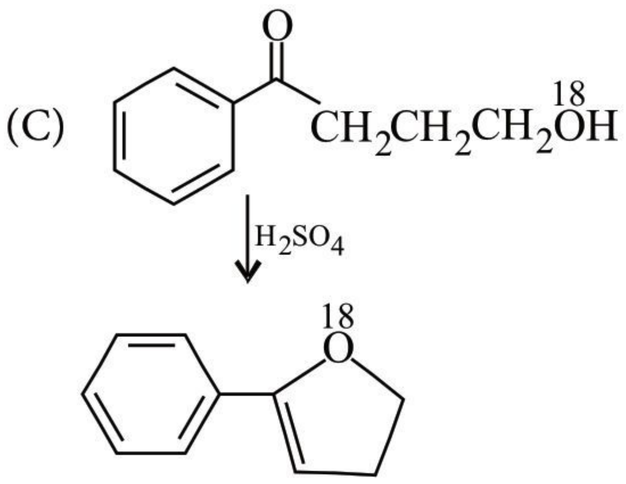
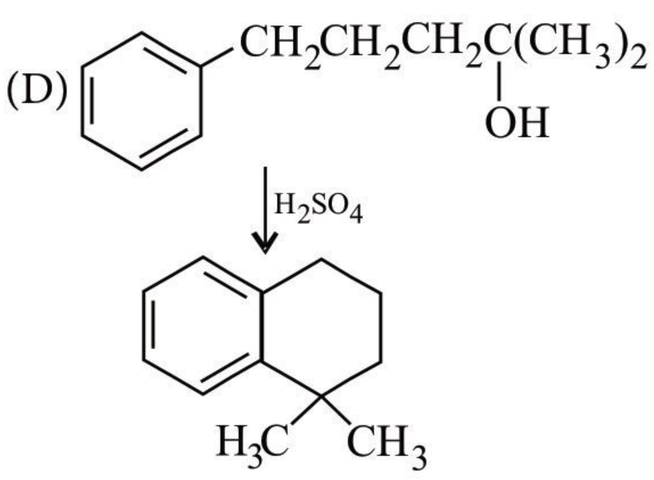
(c) 

(d) 

28. The correct statement with respect to product Y is
(a) it gives a positive Tollens test and is a functional isomer of X.
(b) it gives a positive Tollens test and is a geometrical isomer of X.
(c) it gives a positive iodoform test and is a functional isomer of X.
(d) it gives a positive iodoform test and is a geometrical isomer of X.

Matrix Match Type

29. Match the reactions in column I with appropriate types of steps/reactive intermediate involved in these reactions as given in column II, and select the correct option.

Column I	Column II
(A) 	(p) Nucleophilic substitution
(B) 	(q) Electrophilic substitution
(C) 	(r) Dehydration
(D) 	(s) Nucleophilic addition
	(t) Carbanion

(a) A → p, s; B → r, p; C → q, r, t; D → p, q
(b) A → r, s, t; B → p, s; C → r, s; D → q, r
(c) A → p, q; B → r, s, t; C → r, s; D → q, r
(d) A → r, s, t; B → p, s; C → q, r, s; D → r, s

30. Dilution processes of different aqueous solutions, with water, are given in List-I. The effects of dilution of the solutions on $[H^+]$ are given in List-II.
(Note: Degree of dissociation (α) of weak acid and weak base is $\ll 1$; degree of hydrolysis of salt $\ll 1$; $[H^+]$ represents the concentration of H^+ ions)

List-I	List-II
P. (10 mL of 0.1 M NaOH + 20 mL of 0.1 M acetic acid) diluted to 60 mL	1. The value of $[H^+]$ does not change on dilution
Q. (20 mL of 0.1 M NaOH + 20 mL of 0.1 M acetic acid) diluted to 80 mL	2. The value of $[H^+]$ changes to half of its initial value on dilution
R. (20 mL of 0.1 M HCl + 20 mL of 0.1 M ammonia solution) diluted to 80 mL	3. The value of $[H^+]$ changes to two times of its initial value on dilution
S. 10 mL saturated solution of $Ni(OH)_2$ in equilibrium with excess solid $Ni(OH)_2$ is diluted to 20 mL (solid $Ni(OH)_2$ is still present after dilution).	4. The value of $[H^+]$ changes to $\frac{1}{\sqrt{2}}$ times of its initial value on dilution
	5. The value of $[H^+]$ changes to $\sqrt{2}$ times of its initial value on dilution

Match each process given in List-I with effect in List-II and select the correct option.
(a) P → 4; Q → 2; R → 3; S → 1
(b) P → 4; Q → 3; R → 2; S → 3
(c) P → 1; Q → 4; R → 5; S → 3
(d) P → 1; Q → 5; R → 4; S → 1

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SELF CHECK

No. of questions attempted .....
No. of questions correct .....
Marks scored in percentage .....

Check your score! If your score is

> 90%	EXCELLENT WORK !	You are well prepared to take the challenge of final exam.
90-75%	GOOD WORK !	You can score good in the final exam.
74-60%	SATISFACTORY !	You need to score more next time.
< 60%	NOT SATISFACTORY!	Revise thoroughly and strengthen your concepts.

GET SET GO for JEE

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Practicing these MCQs help to strengthen your concepts and give you extra edge in your JEE preparation

1. The major product *S* of the following reaction sequence is

$$CH_3-\underset{\displaystyle CH_3}{\underset{|}{C}}=CH-CH_2-Cl \xrightarrow{Ag^+/H_2O} (R + R')\ \text{isomers} \xrightarrow{H_2SO_4,\ \Delta} (S)$$

(a) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{C}}=C=CH_2$

(b) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{C}}=CH-CH=CH-CH=\underset{\displaystyle CH_3}{\underset{|}{C}}-CH_3$

(c) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{C}}=CH-CH_3$ (d) $CH_2=\underset{\displaystyle CH_3}{\underset{|}{C}}-CH=CH_2$

2. ΔG is the available energy (energy produced) during the electrochemical reaction in galvanic cell which can be converted into useful work. In the light of second law of thermodynamics in the cell the change in electrode potential with temperature will be equal to

(a) $\frac{\Delta S}{nF}$ (b) $\frac{nF}{\Delta S}$

(c) $-2.303\ RT \log K_c$ (d) $\frac{-2.303\ RT}{nF}$

3. Predict the direction of migration of following tripeptide in neutral aqueous solution.

Lys – Gly – Glu ;

[Lys = $NH_2-(CH_2)_4-\underset{\displaystyle NH_2}{\underset{|}{CH}}-COOH$,

Gly = H_2N-CH_2-COOH,

Glu = $HOOC-(CH_2)_2-\underset{\displaystyle NH_2}{\underset{|}{CH}}-COOH$]

(a) Cathodal (b) Anodal

(c) Stationary (d) Unpredictable

4. Which of the following statements are correct?

(i) The smaller the gold number of lyophilic colloid, the larger will be its protective power.

(ii) Lyophilic sols, in contrast to lyophobic sols can easily coagulate on addition of small amounts of electrolytes.

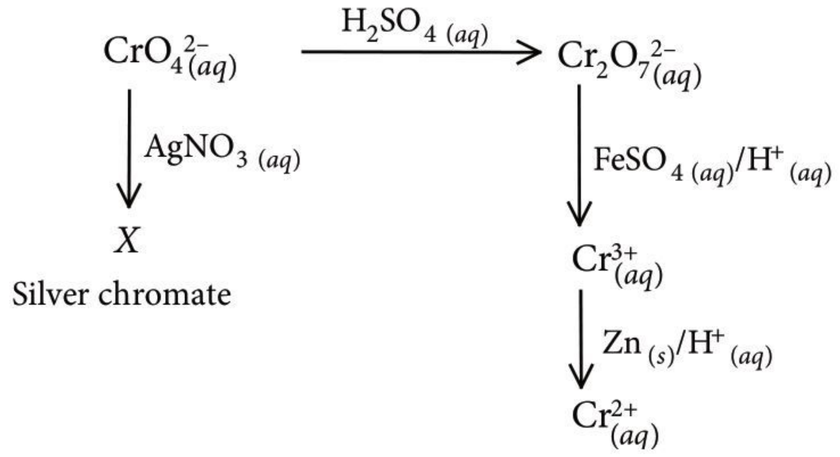
(iii) Ferric chloride solution is used to stop bleeding from a fresh cut because it coagulates the blood.

(iv) The flocculation value of arsenious sulphide sol is independent of the anion of the coagulating electrolyte.

(a) (i), (ii) and (iii) (b) (i), (iii) and (iv)

(c) (ii), (iii) and (iv) (d) (i), (ii) and (iv)

5. Consider the reactions shown below.



Which of the following statements is false?

(a) Silver chromate has the formula Ag_2CrO_4.

(b) The minimum mass of zinc required to reduce 0.100 mole of Cr^{3+} to Cr^{2+} is 6.54 g.

(c) The conversion of CrO_4^{2-} into $Cr_2O_7^{2-}$ is not a redox reaction.

(d) The equation, $Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \rightarrow 6Fe^{3+} + 2Cr^{3+} + 7H_2O$ correctly describes the reduction of $Cr_2O_7^{2-}$ by acidified $FeSO_4$.

6. Vulcanized rubber resists

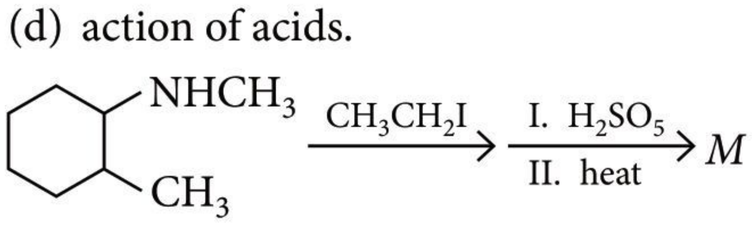
(a) wear and tear due to friction

(b) cryogenic temperature

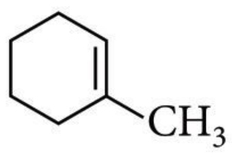
(c) high temperature

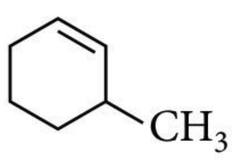
(d) action of acids.

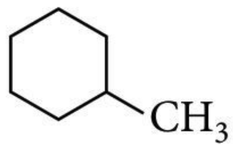
7.



The main product *M* is

(a) 

(b) 

(c) 

(d) $H_2C{=}CH_2$

8. A complex cation is formed by Pt with ligands in proper number so that coordination number of Pt becomes six. Which of the following can be its correct IUPAC name?

(a) Diammineethylenediamminedithiocyanato-S-platinum(II) ion

(b) Diammineethylenediamminedithiocyanato-S-platinate(IV) ion

(c) Diammineethylenediamminedithiocyanato-S-platinum(IV) ion

(d) Diamminebis(ethylenediammine) dithiocyanate- S-platinum(IV) ion.

9. The density of solid argon is 1.65 g per cc at –233°C. If the argon atom is assumed to be a sphere of radius 1.54×10^{-8} cm, what percent of solid argon is apparently empty space? (Ar = 40)

(a) 16.5% (b) 38%

(c) 50% (d) 62%

10. Van Arkel method of purification of metals involves converting the metal into a

(a) volatile stable compound

(b) volatile unstable compound

(c) non volatile stable compound

(d) none of the above.

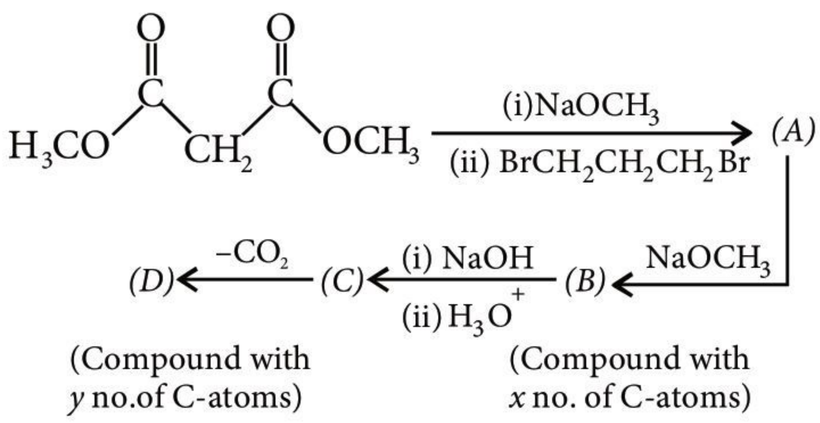
NUMERICAL PROBLEMS

11. Calculate the order of reaction for which rate becomes half if volume of container having same amount of reactant is doubled.
(Assume gaseous phase reaction)

12. A certain mass of a substance when dissolved in 100 g C_6H_6 lowers the freezing point by 1.28°C. The same mass of solute dissolved in 100 g of water lowers the freezing point by 1.40°C. If the substance has normal molecular weight in benzene and is completely dissociated in water, then into how many ions does it dissociate in water? K_f for H_2O and C_6H_6 are 1.86 and 5.12 K mol^{-1} kg respectively.

13. (i) XeO_3, (ii) $XeOF_4$, (iii) XeF_6
Among the following, total number of molecules having equal number of lone pairs on Xe atom are _____.

14.

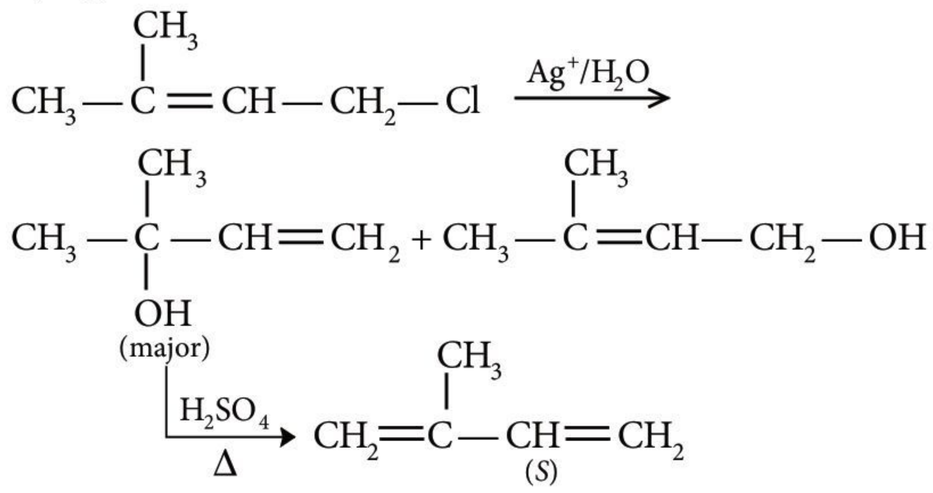


In the above sequence of reactions, $(x - y)$ is _____.

15. (*A*) $C_6H_{14}O$ (alcohol) gives iodoform test when reacts with I_2 in NaOH and produce CHI_3 and (*B*), a salt of monobasic acid is formed. Salt (*B*) on acidification gives 2,2-dimethyl- propanoic acid. The nature of alcoholic group in (*A*) is $x°$. x is _____.

SOLUTIONS

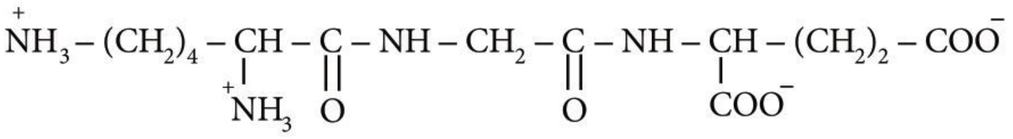
1. **(d):** The presence of Ag^+ causes the reaction to go by S_N1 mechanism.



2. **(a):** According to the second law of thermodynamics

$$\frac{d(\Delta G)}{dT} = -\Delta S, \quad \frac{d(-nFE_{cell})}{dT} = -\Delta S \; ; \; \frac{dE_{cell}}{dT} = \frac{\Delta S}{nF}$$

3. **(c):** In neutral aqueous solution, the tripeptide exists in the zwitter ionic form.



4. **(b):** Lyophilic sols are stable and do not coagulate easily.

5. **(b):** (a) Formula of silver chromate will be Ag_2CrO_4.

(b) Minimum mass of zinc required for reduction of 0.1 mole of Cr^{3+} to Cr^{2+}

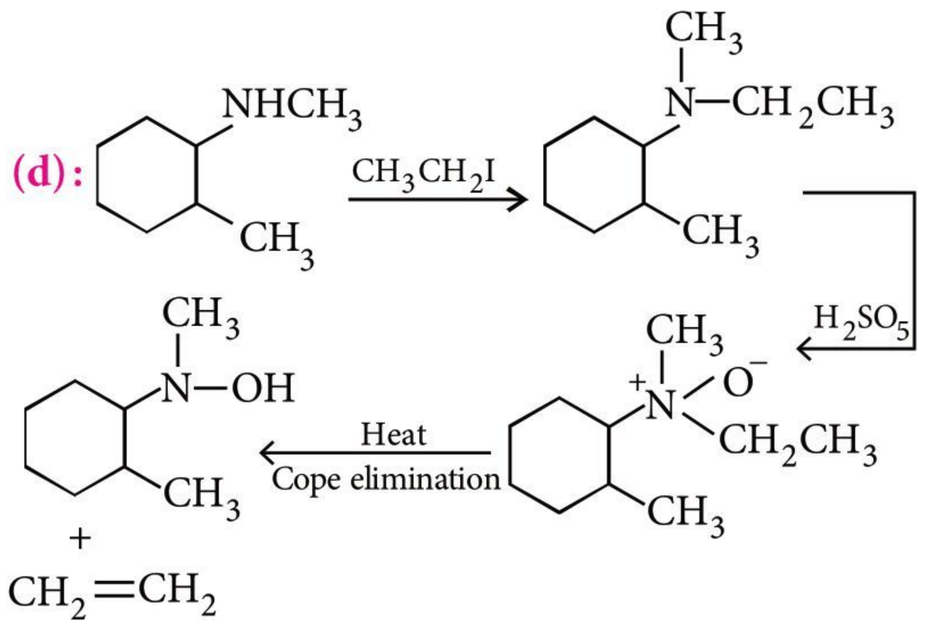
$$= \frac{0.1}{2} \text{ moles of Zn} = \frac{6.54}{2} \text{ g} = 3.27 \text{ g}$$

(c) $CrO_4^{2-} \rightleftharpoons Cr_2O_7^{2-}$
in both ions chromium is in +6 state.

(d) Given reaction is correct.

6. **(a):** Vulcanization is a process of treating natural rubber under heat and sulphur to develop sulphur cross-links that provide strength and resists wear and tear due to friction.

7. **(d):**



The most acidic, least substituted β–H is abstracted out.

8. **(c):** Given compound is $[Pt(NH_3)_2(en)(SCN)_2]^{2+}$ ion.

9. **(d):** Volume of one molecule $= \frac{4}{3}\pi r^3$

$$= \frac{4}{3}\pi(1.54\times10^{-8})^3 \text{ cm}^3 = 1.53 \times 10^{-23} \text{ cm}^3$$

Volume of all molecules in 1.65 g of Ar

$$= \frac{1.65}{40} \times N_A \times 1.53\times10^{-23} = 0.380 \text{ cm}^3$$

Volume of solid containing 1.65 g of Ar = 1 cm^3

$\therefore$ Empty space = 1 – 0.380 = 0.620

$\therefore$ Percent of empty space = 62%

10. **(a):** Van Arkel method involves converting the metal to a volatile stable compound.

For the
SCIENTIST in
YOU

A new, inexpensive catalyst speeds up the production of oxygen from water !!

An electrochemical reaction that splits apart water molecules to produce oxygen is at the heart of multiple approaches aiming to produce alternative fuels for transportation. But this reaction has to be facilitated by a catalyst material, and today's versions require the use of rare and expensive elements such as iridium, limiting the potential of such fuel production.

Now, researchers have developed an entirely new type of catalyst material, called a metal hydroxide-organic framework (MHOF), which is made of inexpensive and abundant components. The family of materials allows engineers to precisely tune the catalyst's structure and composition to the needs of a particular chemical process, and it can then match or exceed the performance of conventional, more expensive catalysts.

Oxygen evolution reactions are one of the reactions common to the electrochemical production of fuels, chemicals, and materials. These processes include the generation of hydrogen as a by product of the oxygen evolution, which can be used directly as a fuel or undergo chemical reactions to produce other transportation fuels; the manufacture of ammonia, for use as a fertilizer or chemical feedstock; and carbon dioxide reduction in order to control emissions. But without help, these reactions are sluggish and need catalyst.

But until now, these catalysts "are all relying on expensive materials or late transition metals that are very scarce, for example iridium oxide, and there has been a big effort in the community to find alternatives based on Earth-abundant materials that have the same performance in terms of activity and stability," researcher says. The team says they have found materials that provide exactly that combination of characteristics.

$$\underset{\text{Impure}}{Ti} + 2I_2 \xrightarrow{500\ K} TiI_4 \text{ (volatile stable);}$$

$$TiI_4 \xrightarrow{1700\ K} \underset{\text{Pure}}{Ti} + 2I_2$$

11. (1): $\text{Rate} = k\left[\frac{n}{V}\right]^x$

For case I : Let a mole of reactant be present in vessel of V litre.

$$\therefore r_1 = k\left[\frac{a}{V}\right]^x \quad \text{... (i)}$$

For case II : The volume is doubled,

$$\therefore \frac{r_1}{2} = k\left[\frac{a}{2V}\right]^x \quad \text{... (ii)}$$

$\therefore$ From equations (i) and (ii),

$2 = (2)^x \therefore x = 1$

12. (3): $\because \Delta T_f = \frac{1000 \times K_f \times w}{W \times m}$

$$\text{In } C_6H_6 : 1.28 = \frac{1000 \times 5.12 \times w}{m_N \times 100} \quad \text{... (i)}$$

$$\text{In } H_2O : 1.40 = \frac{1000 \times 1.86 \times w}{m_{exp} \times 100} \quad \text{... (ii)}$$

(Since given that solute behaves as normal in C_6H_6 and dissociates in water.)

By equation (i) and (ii), $\frac{m_N}{m_{\text{exp}}} = \frac{1.40}{1.28} \times \frac{5.12}{1.86} = 3.01$

$\therefore \quad i = 3.01 = 3.0$

Since solute is 100% ionised, *i.e.*, $\alpha = 1$,

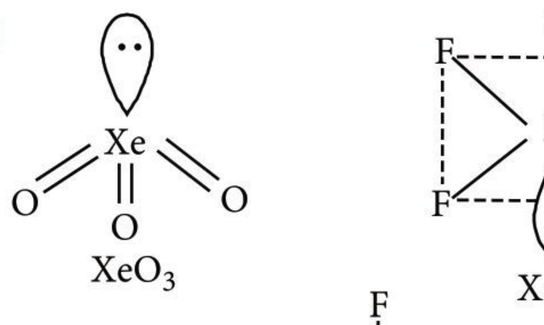
Let solute be A_xB_y

$$\begin{array}{ccccc} A_xB_y & \rightleftharpoons & xA^+ & + & yB^- \\ 1 & & 0 & & 0 \\ (1-\alpha) & & \alpha x & & \alpha y \end{array}$$

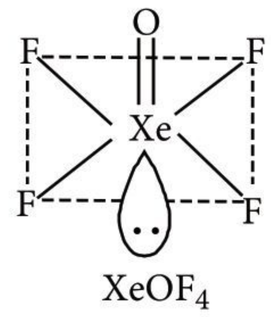
$\therefore \quad i = 1 - \alpha + x\alpha + y\alpha \ \because \ i = 3$ and $\alpha = 1$

$\therefore \quad x + y = 3$ or number of ions given = 3

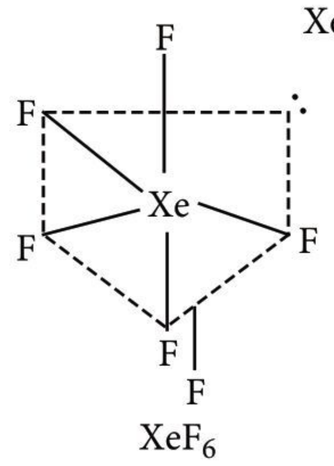
13. (3):



XeO_3

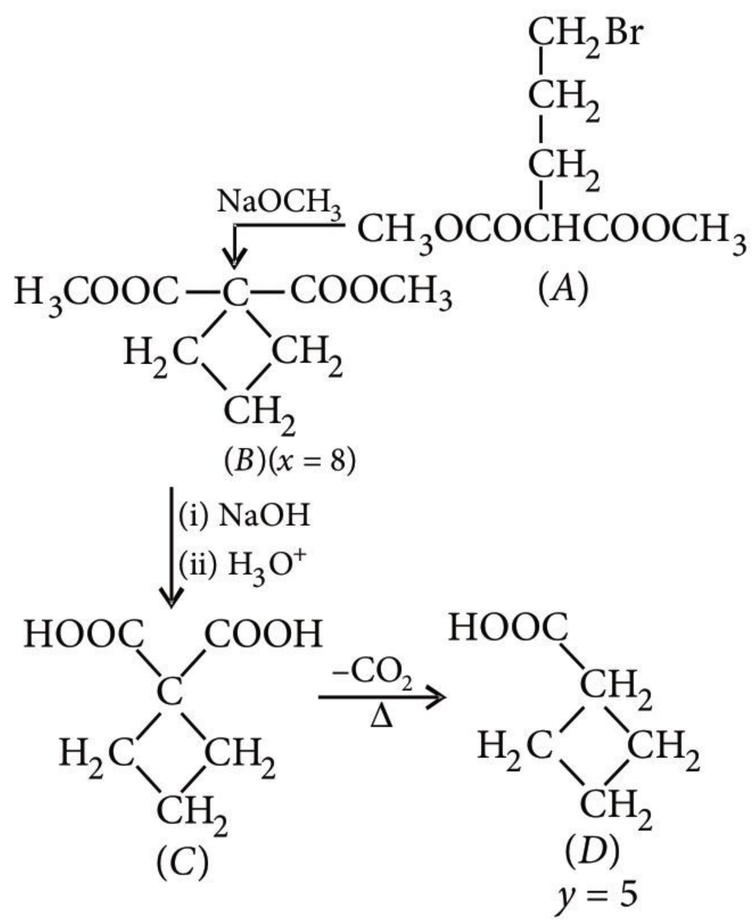


$XeOF_4$



XeF_6

14. (3): $CH_3OCOCH_2COOCH_3 \xrightarrow[\text{(ii) } BrCH_2CH_2CH_2Br]{\text{(i) } NaOCH_3}$



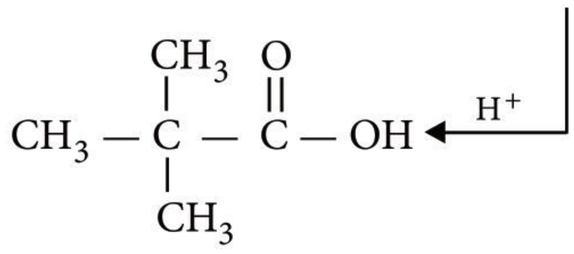
$\therefore \quad x - y = 8 - 5 = 3$

15. (2): Since alcohol (A), ($C_6H_{14}O$) gives iodoform test positively, so, (A) should have $CH_3 - \underset{\displaystyle OH}{\underset{|}{CH}} -$ group.

So, (A) is

$$CH_3 - \underset{\displaystyle OH}{\underset{|}{CH}} - C_4H_9 \xrightarrow{I_2,\ NaOH} \underset{\text{Iodoform}}{CHI_3 \downarrow} + \underset{(B)}{C_4H_9-COONa}$$

(A)



2,2-dimethyl propanoic acid

Hence, C_4H_9 is $CH_3-\underset{\displaystyle CH_3}{\underset{|}{C}}-$ and hence,

(A) is $CH_3 - \underset{\displaystyle OH}{\underset{|}{CH}} - \underset{\displaystyle CH_3}{\underset{|}{C}} - CH_3$ and

(secondary alcoholic group)

(B) is $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{C}} - \underset{\displaystyle O}{\underset{||}{C}} - ONa$

CBSE warm-up!

Term-II Exam on 7th May

CLASS-XII

Practice Paper 2022

Time Allowed : 2 hours
Maximum Marks : 35

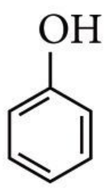
General Instructions : Read the following instructions carefully.

1. *There are 12 questions in this question paper with internal choice.*
2. *SECTION A - Q. No. 1 to 3 are very short answer questions carrying 2 marks each.*
3. *SECTION B - Q. No. 4 to 11 are short answer questions carrying 3 marks each.*
4. *SECTION C - Q. No. 12 is case based question carrying 5 marks.*
5. *All questions are compulsory.*
6. *Use of log tables and calculators is not allowed.*

SECTION - A

1. Which acid of each pair shown here would you expect to be stronger?

(i) $F—CH_2—COOH$ or $Cl—CH_2—COOH$

(ii)  or CH_3COOH

2. Give reasons for the following observations :

(i) NH_3 gas adsorbs more readily than N_2 gas on the surface of charcoal.

(ii) Powdered substances are more effective adsorbents.

3. How would you account for the following :

(i) Aniline is a weaker base than cyclohexylamine.

(ii) Methylamine in aqueous medium gives reddish-brown precipitate with $FeCl_3$.

SECTION - B

4. In a pseudo first order hydrolysis of ester in water, the following results are obtained :

t in seconds	0	30	60	90
[Ester]M	0.55	0.31	0.17	0.085

(i) Calculate the average rate of reaction between the time interval 30 to 60 seconds.

(ii) Calculate the pseudo first order rate constant for the hydrolysis of ester.

OR

For the first order thermal decomposition reaction, the following data were obtained :

$C_2H_5Cl_{(g)} \longrightarrow C_2H_{4(g)} + HCl_{(g)}$

Time/sec	Total pressure/atm
0	0.30
300	0.50

Calculate the rate constant.

(Given : log 2 = 0.301, log 3 = 0.4771, log 4 = 0.6021)

5. Following are the transition metal ions of 3*d* series : Ti^{4+}, V^{2+}, Mn^{3+}, Cr^{3+}

(Atomic numbers : Ti = 22, V = 23, Mn = 25, Cr = 24)

Answer the following :

(i) Which ion is most stable in aqueous solution and why?
(ii) Which ion is strongest oxidising agent and why?
(iii) Which ion is colourless and why?

6. Write the chemical equations for the following conversions :
(i) Ethyl isocyanide to ethylamine.
(ii) Aniline to benzonitrile.
(iii) Aniline to *p*-nitroaniline.

OR

(a) Give one chemical test to distinguish between the compounds of the following pairs :
(i) CH_3NH_2 and $(CH_3)_2NH$
(ii) $(C_2H_5)_2NH$ and $(C_2H_5)_3N$
(b) Why aniline does not undergo Friedel–Crafts reaction?

7. How would you account for the following :
(i) The oxidising power of oxoanions are in the order $VO_2^+ < Cr_2O_7^{2-} < MnO_4^-$
(ii) The third ionization enthalpy of manganese ($Z = 25$) is exceptionally high.
(iii) Cr^{2+} is a stronger reducing agent than Fe^{2+}.

8. (i) Write the structures of compounds *A*, *B* and *C* in each of the following reactions :

(a) $C_6H_5Br \xrightarrow{Mg/\text{dry ether}} A \xrightarrow[(b)\ H_3O^+]{(a)\ CO_{2(g)}} B \xrightarrow{PCl_5} C$

(b) $CH_3CN \xrightarrow[(b)\ H_3O^+]{(a)\ SnCl_2/HCl} A \xrightarrow{\text{dil. NaOH}} B \xrightarrow{\Delta} C$

(ii) Do the following conversion in not more than two steps :
Benzoic acid to benzaldehyde

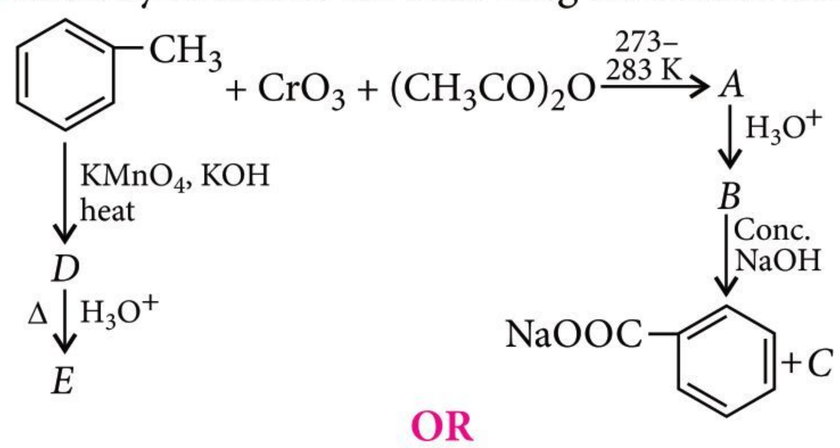
9. Explain what is observed when :
(i) A beam of light is passed through a colloidal solution.
(ii) NaCl solution is added to hydrated ferric oxide sol.
(iii) Electric current is passed through a colloidal solution.

OR

(i) Write the state of dispersed phase and dispersion medium of the following colloidal systems :
(a) Smoke (b) Milk
(ii) In reference to Freundlich adsorption isotherm write the expression for adsorption of gases on solids in the form of an equation.

10. Write the state of hybridization, the shape and the magnetic behaviour of the following complex entities :
(i) $[Cr(NH_3)_4Cl_2]Cl$ (ii) $[Co(en)_3]Cl_3$
(iii) $K_2[Ni(CN)_4]$

11. Identify *A* to *E* in the following series of reactions



OR

Two moles of organic compound '*A*' on treatment with a strong base gives two compound '*B*' and '*C*'. Compound '*B*' on dehydrogenation with Cu gives '*A*' while acidification of '*C*' yields carboxylic acid '*D*' with molecular formula of CH_2O_2. Identify the compounds *A*, *B*, *C* and *D* and write all chemical reactions involved.

SECTION - C

12. Read the passage given below and answer the questions that follow:

Nernst equation relates the reduction potential of an electrochemical reaction to the standard potential and activities of the chemical species undergoing oxidation and reduction.

Let us consider the reaction, $M^{n+}_{(aq)} \longrightarrow nM_{(s)}$

For this reaction, the electrode potential measured with respect to standard hydrogen electrode can be given as

$$E_{(M^{n+}/M)} = E^\circ_{(M^{n+}/M)} - \frac{RT}{nF} \ln \frac{1}{[M^{n+}]}$$

(a) Electrode potential for the following half-cell reactions are

$Zn \rightarrow Zn^{2+} + 2e^-$; $E^\circ = +0.76$ V;

$Fe \rightarrow Fe^{2+} + 2e^-$; $E^\circ = +0.44$ V.

The standard EMF for the cell reaction

$Fe^{2+} + Zn \rightarrow Zn^{2+} + Fe$ will be

(b) Write the correct Nernst equation for the given cell.

$Fe_{(s)}|Fe^{2+}(0.001\ M)||H^+(1\ M)\ |\ H_{2(g)}(1\ bar)|Pt_{(s)}$

(c) Calculate the potential of hydrogen electrode in contact with a solution whose pH is 10.

(d) If E° for copper electrode is 0.34 V, how will you calculate its emf value when the solution in contact with it is 0.1 M in copper ions? How does emf for copper electrode change when concentration of Cu^{2+} ions in the solution is decreased?

OR

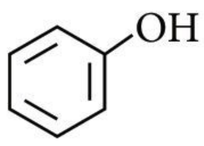
E°_{cell} for the given redox reaction is 2.71 V.

$Mg_{(s)} + Cu^{2+}(0.01M) \rightarrow Mg^{2+}(0.001M) + Cu_{(s)}$

Calculate E_{cell} for the reaction.

SOLUTIONS

1. **(i)** $F-CH_2COOH$ is more acidic than $Cl-CH_2COOH$

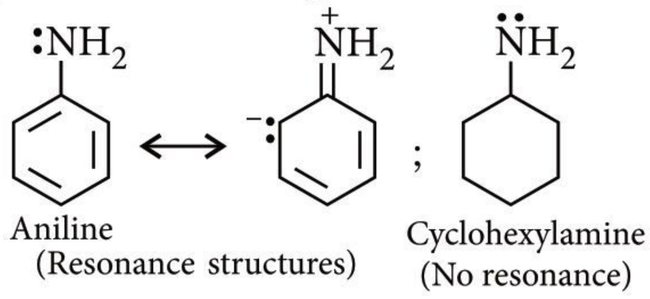
(ii) CH_3COOH is stronger acid than 

2. **(i)** Higher the critical temperature of the gas, more readily it can get adsorbed on the surface of an adsorbent since van der Waals' forces are stronger at this temperature.

NH_3 has a higher critical temperature (132°C) than dinitrogen (–147°C) thus, it gets adsorbed more readily than N_2.

(ii) A finely divided substance is more effective as adsorbent because it has more surface area and more number of active sites (active centres) which increases the extent of adsorption.

3. **(i)** Aniline is weaker base than cyclohexylamine because of resonance. The lone pair on nitrogen is attracted by benzene ring, hence, donor tendency of $-\ddot{N}H_2$ group decreases. There is no resonance in cyclohexylamine. Electron repelling nature of cyclohexyl group further increases the donor property of NH_2 group. So, cyclohexylamine is a stronger base.



Aniline (Resonance structures) Cyclohexylamine (No resonance)

(ii) Methylamine forms hydroxide ions when dissolved in water due to the following acid - base equilibrium.

$$CH_3-NH_2 + H_2O \rightleftharpoons CH_3-\overset{+}{N}H_3 + OH^-$$

These OH^- ions react with Fe^{3+} ions to form red ppt. of ferric hydroxide.

$$2Fe^{3+} + 6OH^- \longrightarrow 2Fe(OH)_3$$

4. **(i)** Average rate of reaction between the time interval 30 to 60 seconds is

$$r_{av} = \frac{-[0.17-0.31]}{60-30} = \frac{0.14}{30}$$

$= 4.67 \times 10^{-3}\ s^{-1}$ [Taking only difference]

(ii) $k = \frac{2.303}{t}\log\frac{[R]_0}{[R]}$

At $t = 30$ s,

$$k = \frac{2.303}{30}\log\frac{0.55}{0.31} = \frac{2.303}{30}\times 0.249 = 1.91\times10^{-2}\ s^{-1}$$

At $t = 60$ s,

$$k = \frac{2.303}{60}\log\frac{0.55}{0.17} = \frac{2.303}{60}\times 0.5099 = 1.96\times10^{-2}\ s^{-1}$$

At $t = 90$ s

$$k = \frac{2.303}{90}\log\frac{0.55}{0.085}$$

$$k = \frac{2.303}{90}\times 0.8109 = 2.07\times10^{-2}\ s^{-1}$$

$\therefore$ Average value of k

$$= \frac{1.91\times10^{-2} + 1.96\times10^{-2} + 2.07\times10^{-2}}{3} = 1.98\times10^{-2} s^{-1}$$

OR

The given reaction is

$$C_2H_5Cl_{(g)} \longrightarrow C_2H_{4(g)} + HCl_{(g)}$$

At time $t = 0$	0.30 atm	0	0
At time $t = 300$ sec	$0.30 - x$	x	x

Total pressure $= 0.30 - x + x + x = 0.50$

or $0.30 + x = 0.50$

$\therefore$ $x = 0.50 - 0.30 = 0.20$

$\therefore$ Initial pressure, $P_0 = 0.30$ atm

Pressure of C_2H_5Cl after 300 sec,

$P_t = 0.30 - 0.20 = 0.10$ atm

Using formula for first order reaction,

$$k = \frac{2.303}{t}\log\left(\frac{P_0}{P_t}\right)$$

$$k = \frac{2.303}{300}\log\left(\frac{0.30}{0.10}\right)$$

$$k = \frac{2.303}{300}\log 3 = \frac{2.303\times0.4771}{300} = 3.66\times10^{-3}\ sec^{-1}$$

5. **(i)** Ti^{4+} has highest oxidation state among the given ions. Ti^{4+} has stable inert gas configuration and hence, most stable in aqueous solution.

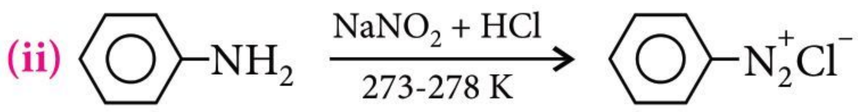
On the other hand, V^{2+}, Mn^{3+}, Cr^{3+} have unstable electronic configuration and hence, are less stable.

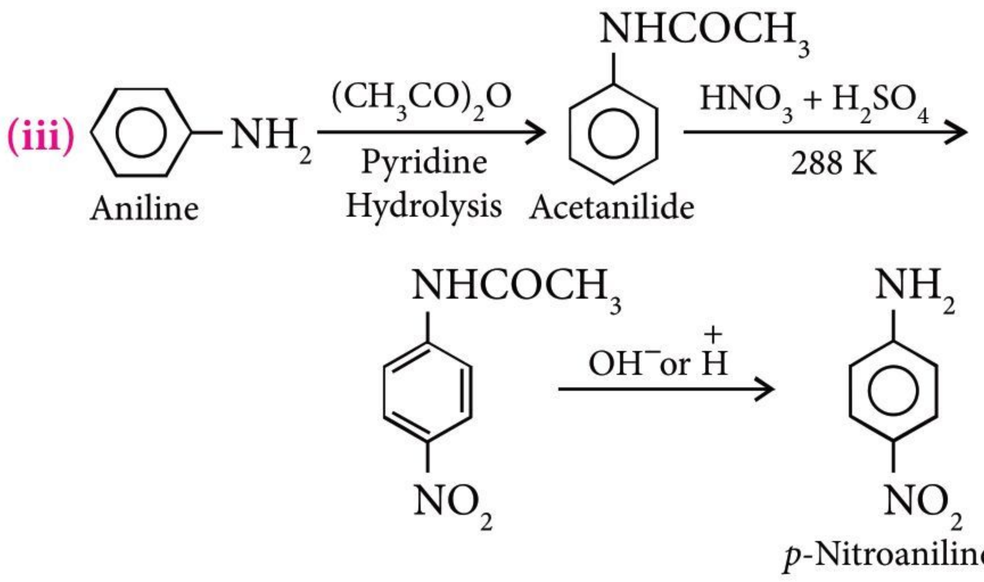
(ii) Due to presence of highest oxidation state of Ti, it acts as the strongest oxidising agent among the given ions.

(iii) Due to absence of electron in Ti^{4+}, so, there is no *d-d* transition, hence it is a colourless ion.

E.C. of Ti^{4+} : $[Ar]3d^0 4s^0$

6. **(i)** $\underset{\text{Ethyl isocyanide}}{C_2H_5-N \equiv C} + 2H_2O \xrightarrow[\text{Hydrolysis}]{H^+} \underset{\text{Ethylamine}}{C_2H_5NH_2} + HCOOH$

(ii) 

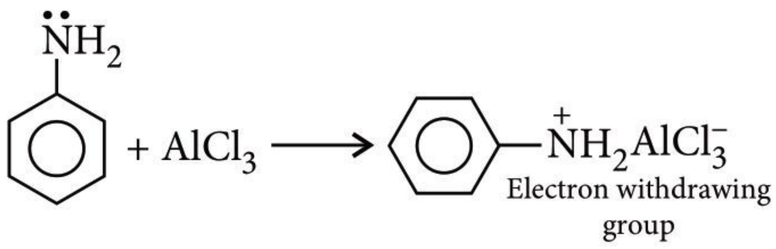
(iii) 

OR

(a) (i) Methylamine gives carbylamine test, *i.e.*, on treatment with alc. KOH and chloroform, followed by heating it gives offensive odour of methyl isocyanide. Dimethylamine does not give this test.

(ii) $(C_2H_5)_2NH$ and $(C_2H_5)_3N$ can be distinguish by Hinsberg's reagent. As 2° amine contains one hydrogen thus it reacts with Hinsberg's reagent and the product formed is insoluble in alkali. While, 3° amine do not react with benzenesulphonyl chloride.

(b) In Friedel Crafts reaction, $AlCl_3$ is added as a catalyst which is a Lewis acid. It forms a salt with aniline due to which the nitrogen of aniline acquires positive charge. This positively charged nitrogen acts as a strong deactivating group, hence aniline does not undergo Friedel Crafts reaction.

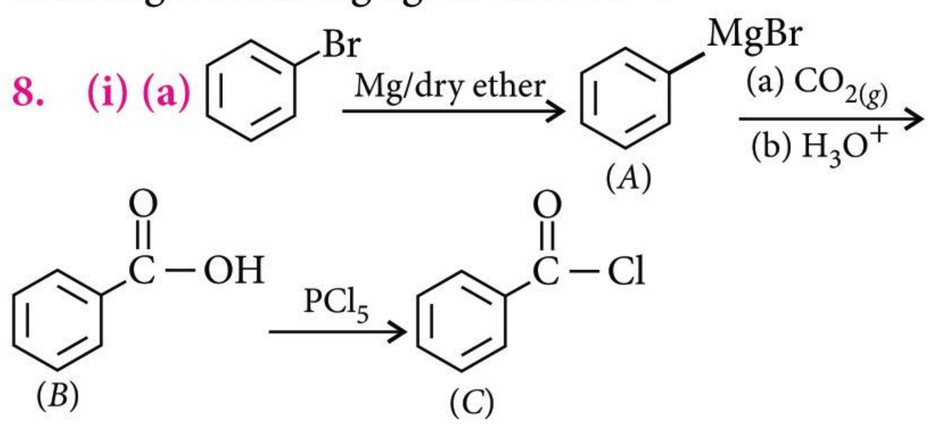


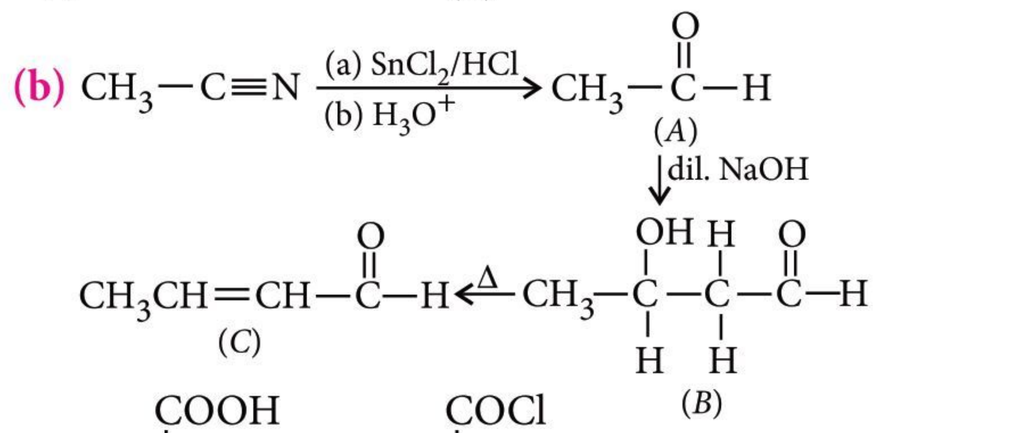
7. **(i)** Change in $Cr_2O_7^{2-}$ to Cr(III) is 3 and in MnO_4^- to Mn (II) is 5.

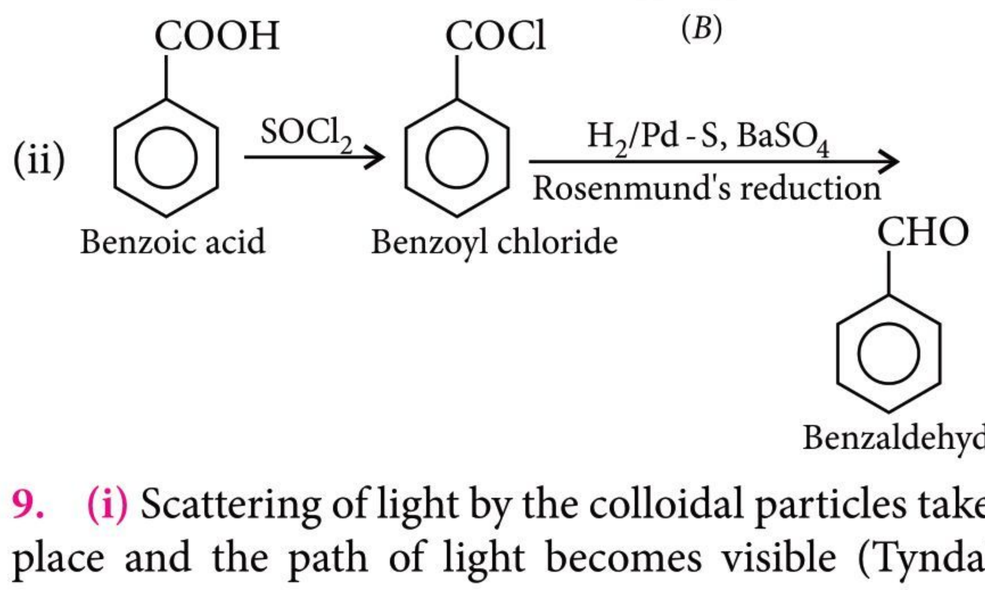
Change in oxidation state is large and the stability of reduced products is in the order: V(III) < Cr(III) < Mn(II). This is why oxidising power of oxoanions are in the order : $VO_2^+ < Cr_2O_7^{2-} < MnO_4^-$.

(ii) Third ionization enthalpy of Mn is very high because the third electron has to be removed from the stable half-filled 3*d*-orbitals [Mn^{2+} ($Z = 25$) = $3d^5$].

(iii) Cr^{2+} is a stronger reducing agent than Fe^{2+}. $E°_{Cr^{3+}/Cr^{2+}}$ is negative (–0.41 V) whereas $E°_{Fe^{3+}/Fe^{2+}}$ is positive (+ 0.77 V). Thus Cr^{2+} is easily oxidized to Cr^{3+} but Fe^{2+} cannot be easily oxidized to Fe^{3+}. Hence, Cr^{2+} is stronger reducing agent than Fe^{2+}.

8. **(i)** **(a)** 

(b) 

(ii) 

9. **(i)** Scattering of light by the colloidal particles takes place and the path of light becomes visible (Tyndall effect).

(ii) The positively charged colloidal particles of ferric hydroxide sol get coagulated by the oppositely charged Cl^- ions provided by NaCl.

COMIC CAPSULE

My cousin : what's your pc password?

Me : 53952952

My cousin : why these numbers?

Iodine	Americium	Copper	Tellurium
53	95	29	52
I	Am	Cu	Te
126.90	243	63.54	127.60

(iii) On passing electric current through a sol, colloidal particles start moving towards oppositely charged electrodes where they lose their charge and get coagulated (electrophoresis).

OR

(i) (a) Dispersed phase of smoke = Solid
Dispersion medium of smoke = Gas
(b) Dispersed phase of milk = liquid (Fat)
Dispersion medium of milk = liquid (Water)

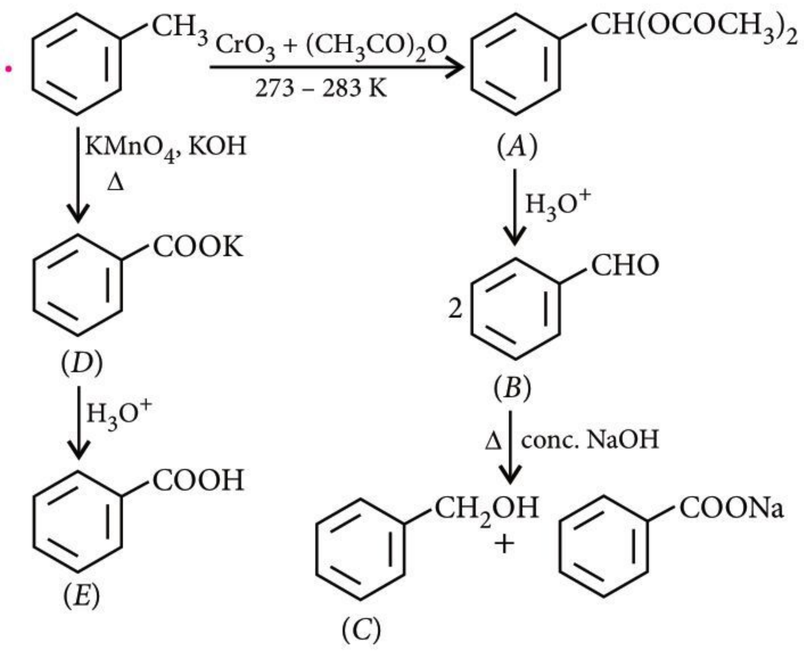
(ii) $\frac{x}{m} = kp^{1/n} (n > 1)$; $\log \frac{x}{m} = \log k + \frac{1}{n} \log p$

where, x is the mass of gas adsorbed on mass m of the adsorbent at pressure p.

10.

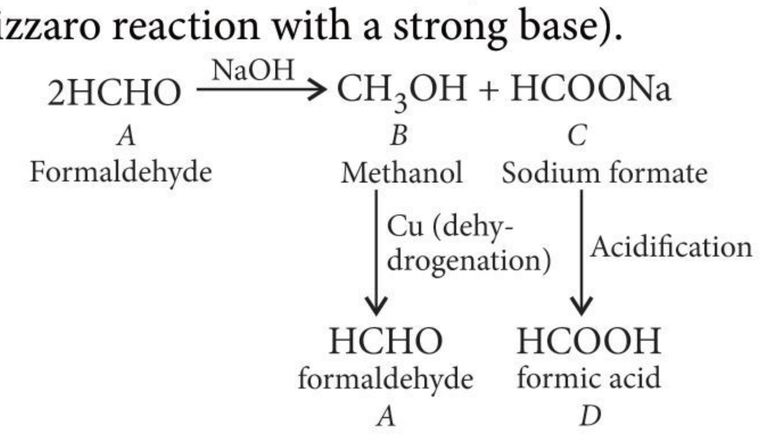
Complex	Central metal ion/ atom	Hybridi-sation of metal ion involved	Geometry of complex	Magnetic behaviour
$[Cr(NH_3)_4Cl_2]Cl$	Cr^{3+}	d^2sp^3	Octahedral	Paramagnetic
$[Co(en)_3]Cl_3$	Co^{3+}	d^2sp^3	Octahedral	Diamagnetic
$K_2[Ni(CN)_4]$	Ni^{2+}	dsp^2	Square planar	Diamagnetic

11.



OR

Since the molecular formula of D is CH_2O_2, thus, D is HCOOH (formic acid). D is obtained by the acidification of C, so, C is sodium formate (HCOONa). Thus, A must be formaldehyde (as it undergoes Cannizzaro reaction with a strong base).



Thus, A = Formaldehyde (HCHO)
B = Methanol (CH_3OH)
C = Sodium formate (HCOONa)
D = Formic acid (HCOOH)

12. (a) $E^\circ_{Zn/Zn^{2+}} = +0.76$ V

$E^\circ_{Fe/Fe^{2+}} = 0.44$ V $\Rightarrow$ $E^\circ_{Fe^{2+}/Fe} = -0.44$ V

$E^\circ_{cell} = E^\circ_{O.P.} + E^\circ_{R.P.} = +0.76 - 0.44 = +0.32$ V

(b) At anode : $Fe \rightarrow Fe^{2+}(0.001\ M) + 2e^-$

At cathode : $2H^+ (1\ M) + 2e^- \rightarrow H_2$ (1 bar)

Net reaction : $Fe + 2H^+ \rightarrow Fe^{2+} + H_2$

Nernst equation for the given cell,

$$E_{cell} = E^\circ_{cell} - \frac{0.0591}{2} \log \frac{[Fe^{2+}][H_2]}{[Fe][H^+]^2}$$

$$E_{cell} = E^\circ_{cell} - \frac{0.0591}{2} \log \frac{(0.001)(1)}{(1)^2}$$

(c) For hydrogen electrode, $H^+ + e^- \longrightarrow \frac{1}{2} H_2$

From Nernst equation,

$$E_{H^+/H_2} = E^\circ_{H^+/H_2} - \frac{0.0591}{n} \log \frac{1}{[H^+]}$$

$$= 0 - \frac{0.0591}{1} \log \frac{1}{10^{-10}}$$

$= -0.0591 \times 10 = -0.591$ V

(d) $Cu^{2+}_{(aq)} + 2e^- \rightarrow Cu_{(s)}$

$$E_{Cu^{2+}/Cu} = E^\circ_{Cu^{2+}/Cu} - \frac{0.059}{2} \log \frac{[Cu]}{[Cu^{2+}]}$$

$$= 0.34 - \frac{0.059}{2} \log \frac{1}{0.1} = 0.34 - \frac{0.059}{2} \log 10$$

$$= 0.34 - \frac{0.059}{2} \times (1) = 0.34 - 0.0295 = 0.3105 \text{ V}$$

When the concentration of Cu^{2+} ions is decreased, the electrode potential for copper decreases.

OR

$$E_{cell} = E^\circ_{cell} - \frac{0.0591}{n} \log \frac{[Mg^{2+}]}{[Cu^{2+}]}$$

$$= 2.71 - \frac{0.0591}{2} \log \frac{0.001}{0.01} = 2.73955 \text{ V}$$

$\therefore$ E_{cell} for the given reaction is 2.74 V.

MONTHLY TEST DRIVE

Practice Paper

This specially designed column enables students to self analyse their extent of understanding complete syllabus. Give yourself four marks for correct answer and deduct one mark for wrong answer. Self check table given at the end will help you to check your readiness.

Total Marks : 120 **Time Taken : 60 Min.**

NEET

Only One Option Correct Type

1. Iodine pentoxide on heating with dry HCl gives

I. ICl_3 II. Cl_2 III. ICl_5 IV. ICl

(a) I, II (b) I, III

(c) I, II, III, IV (d) I, II, III

2. Ratio of the total volume of *bcc* to simple cubic structure is

(a) $3\sqrt{3}:8$ (b) $8:3\sqrt{3}$

(c) $24\sqrt{3}:1$ (d) $1:24\sqrt{3}$

3. Which of the following statements is not correct?

(a) $La(OH)_2$ is less basic than $Lu(OH)_3$.

(b) In lanthanide series ionic radius of Ln^{3+} ions decreases.

(c) La is actually an element of transition series rather than lanthanoid series.

(d) Atomic radii of Zr and Hf are same because of lanthanoid contraction.

4. The bromination of acetone that occurs in acid solution is represented by this equation,

$$CH_3COCH_{3(aq)} + Br_{2(aq)} \rightarrow CH_3COCH_2Br_{(aq)} + H^+_{(aq)} + Br^-_{(aq)}$$

These kinetic data were obtained for given reaction concentrations.

$[CH_3COCH_3]$	$[Br_2]$	$[H^+]$	rate of disappearance of Br_2, $(M\ s^{-1})$
0.30	0.05	0.05	5.7×10^{-5}
0.30	0.10	0.05	5.7×10^{-5}
0.30	0.10	0.10	1.2×10^{-4}
0.40	0.05	0.20	3.1×10^{-4}

Based on these data, the rate equation is

(a) Rate = $k\,[CH_3COCH_3][Br_2][H^+]^2$

(b) Rate = $k\,[CH_3COCH_3][Br_2][H^+]$

(c) Rate = $k\,[CH_3COCH_3][H^+]$

(d) Rate = $k\,[CH_3COCH_3][Br_2]$

5. In the given reaction,

$$BrF_2C(H_3C)C{=}C(F)F \xrightarrow{CH_3CH_2O^-\,(1eq)} [X]$$

The major product (X) is

(a) $EtOF_2C(H_3C)C{=}C(F)F$ (b) $F_2C(H_3C)C{=}C(OEt)-C(F)F$

(c) $BrF_2C(H_3C)C{=}C(OEt)F$ (d) $EtOBrFC(H_3C)C{=}CF_2$

6. A student made the following observations in the laboratory.

(i) Clean copper metal did not react with 1 molar $Pb(NO_3)_2$ solution.

(ii) Clean lead metal dissolved in a 1 molar $AgNO_3$ solution and crystals of Ag metal appeared.

(iii) Clean silver metal did not react with 1 molar $Cu(NO_3)_2$ solution.

The decreasing order of reducing character of three metals is

(a) Cu, Pb, Ag (b) Cu, Ag, Pb

(c) Pb, Cu, Ag (d) Pb, Ag, Cu

7. $CH_3CH_2CH{=}CH_2 \xrightarrow{HBr/H_2O_2} Y \xrightarrow{C_2H_5ONa} Z$

Identify Z in the above reaction.

(a) $(CH_3)_2CHOCH_2CH_3$

(b) $CH_3CH_2CH(CH_3)OCH_2CH_3$

(c) $CH_3(CH_2)_3OCH_2CH_3$

(d) $CH_3(CH_2)_4OCH_3$

8. One of the most known antiseptics, dettol is a mixture of terpenol and
   (a) chloroxylenol (b) bithional
   (c) *o*-cresol (d) serotonin.

9. Which of the following reactions is used in thermite welding?
   (a) $TiO_2 + 4Na \rightarrow Ti + 2Na_2O$
   (b) $Cr_2O_3 + 2Al \rightarrow Al_2O_3 + 2Cr$
   (c) $3Mn_3O_4 + 8Al \rightarrow 4Al_2O_3 + 9Mn$
   (d) $2Al + Fe_2O_3 \rightarrow Al_2O_3 + Fe$

10. Which one of the following monomers gives the polymer neoprene on polymerization?
   (a) $CH_2{=}CHCl$
   (b) $CCl_2{=}CCl_2$
   (c) $CH_2{=}CCl{-}CH{=}CH_2$
   (d) $CF_2{=}CF_2$

11. The change in optical rotation with time of freshly prepared solution of reducing sugar is known as
   (a) inversion (b) specific rotation
   (c) rotatory motion (d) mutarotation.

12. One desires to prepare a positively charged sol of silver iodide. This can be achieved by
   (a) adding a little $AgNO_3$ solution to KI solution in slight excess
   (b) adding a little KI solution to $AgNO_3$ solution in slight excess
   (c) mixing equal volumes of equimolar solutions of $AgNO_3$ and KI
   (d) none of these.

Assertion & Reason Type

Directions : In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as :
(a) If both assertion and reason are true and reason is the correct explanation of assertion.
(b) If both assertion and reason are true but reason is not the correct explanation of assertion.
(c) If assertion is true but reason is false.
(d) If both assertion and reason are false.

13. **Assertion :** For a second order reaction, graph of $1/[A]$ vs. t is a straight line.
   Reason : For second order reaction, $[A] = kt + \dfrac{1}{[A_0]}$

14. **Assertion :** P_4 is more reactive than N_2.
   Reason : P—P single bond in P_4 is much weaker than N≡N in N_2 molecule.

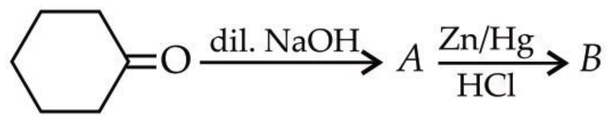
15. **Assertion :** In order to convert R—Cl to pure R—NH_2, Gabriel phthalimide synthesis can be used.
   Reason : With proper choice of alkyl halides, pthalimide synthesis can be used to prepare 1°, 2° or 3° amines.

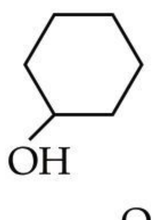
JEE MAIN / JEE ADVANCED

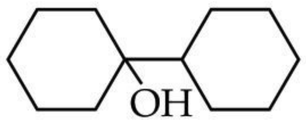
Only One Option Correct Type

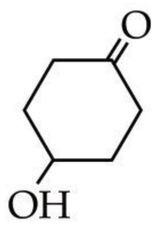
16. Which of the following statements is true?
   (a) If $\Delta_o > P$, strong field ligands and low spin complexes.
   (b) If $\Delta_o < P$, strong field ligands and high spin complexes.
   (c) If $\Delta_o > P$, weak field ligands and low spin complexes.
   (d) If $\Delta_o < P$, weak field ligands and low spin complexes.

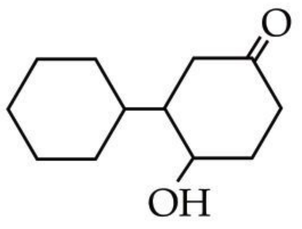
17. Product *B* in the following reactions sequence is



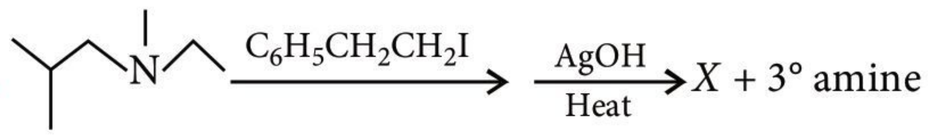
(a) 

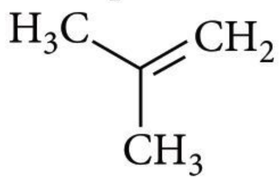
(b) 

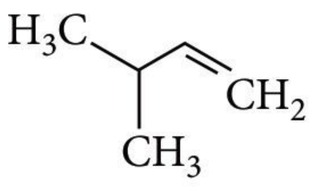
(c) 

(d) 

18. Ba^{2+}, CN^- and Co^{2+} ions form an ionic complex. If this complex is 75% ionised in aqueous solution with van't Hoff factor (i) equal to four and paramagnetic moment is found to be 1.73 BM (due to spin only) then the hybridisation state of Co (II) in the complex will be
   (a) sp^3d (b) d^2sp^3
   (c) sp^3d^2 (d) dsp^3

19. 

The final product '*X*' is
   (a) 

   (b) $CH_2{=}CH_2$
   (c) $C_6H_5CH{=}CH_2$
   (d) 

More than One Option Correct Type

20. Which of the following statements is/are wrong?

(a) Ti^{4+} and Ag^{+} are repelled by magnetic field.

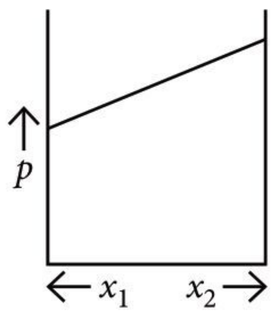
(b) Mn^{2+} shows maximum magnetic character among the first transition series.

(c) Fe^{2+} is more stable than Mn^{2+} towards oxidation to +3 state.

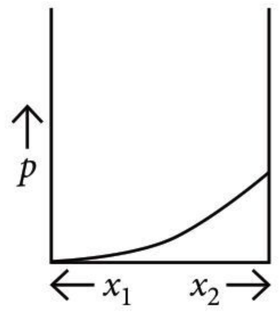
(d) Cr in $Cr_2O_7^{2-}$ ion involves sp^3d^3 hybridisation.

21. For a binary ideal liquid solution, the variation in total vapour pressure versus composition of solution is given by which of the curves?

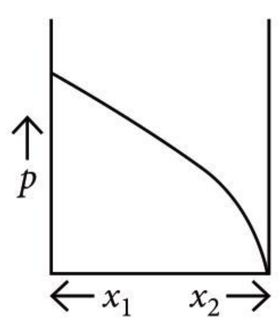
(a)



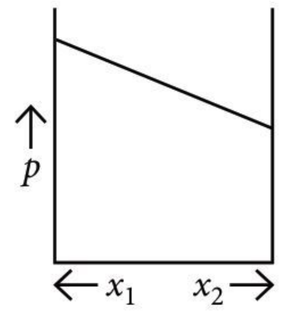
(b)



(c)



(d)



22. Which of the following reactions occur during calcination?

(a) $CaCO_3 \longrightarrow CaO + CO_2$

(b) $2FeS_2 + \frac{11}{2} O_2 \longrightarrow Fe_2O_3 + 4SO_2$

(c) $Al_2O_3 \cdot xH_2O \longrightarrow Al_2O_3 + xH_2O$

(d) $ZnS + \frac{3}{2} O_2 \longrightarrow ZnO + SO_2$

23. Which of the following reactions are correctly interpreted?

(a) $(CH_3)_3C{-}CH{=}CH_2 + Hg(OAc)_2 \xrightarrow{H_2O,\ NaBH_4} (CH_3)_3C{-}CH_2CH_2OH$

3 Amazing Facts You Must Know

1. Rainwater holds Vit-B12.

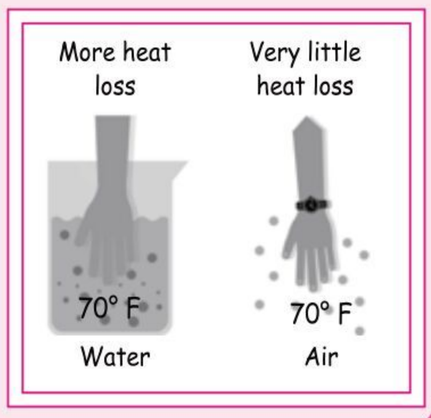
As rainwater falls through the air and washes down roof tops, microorganisms can get caught up inside it and these organisms can produce vitamin B12 as a metabolic by product. Rain does not inherently contain vitamin B12.

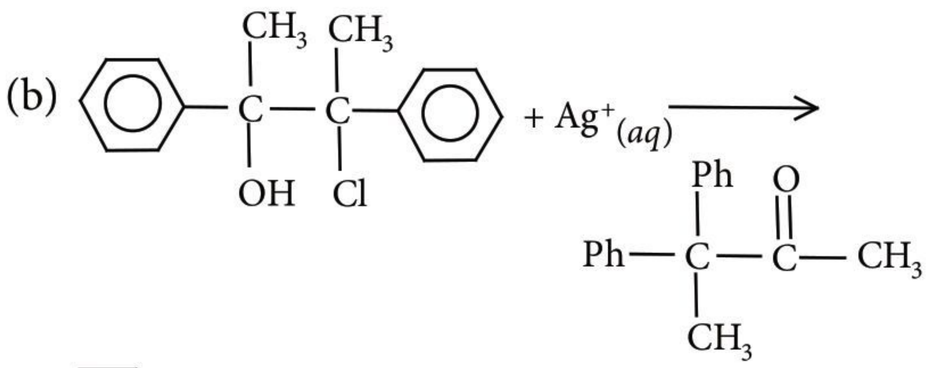
2. Airbags in cars are manufactured with Poisonous Sodium Azide.

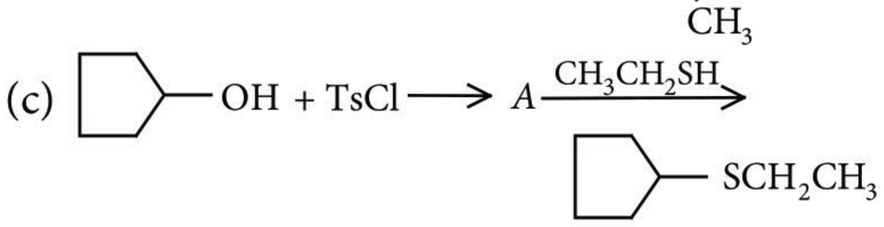
Many car airbag inflators contain small amounts of a toxic molecule called sodium azide, NaN_3. Sodium azide is quite stable under normal conditions, but on heating it breaks down very quickly to sodium and nitrogen gas. Nitrogen gas fills the air bag which saves the driver. A handful of sodium azide (*i.e.*, 130 g) will produce 67 L of nitrogen gas which is quite enough to inflate a normal air bag.

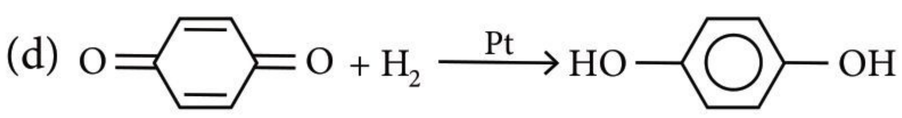
3. Water feels colder than air at same temperature.

If we compare water, and atmospheric air at the same temperature, water will always feel relatively colder. This is because of the much higher specific heat capacity of water (4.18 J/g °C as compared to air's ~1 J/g °C). That means it requires over four times as much heat energy to heat a gram of water per °C than one gram of air. Thus, when your skin senses the relative "coldness" of water and air, water will feel colder as it is less susceptible to temperature change.



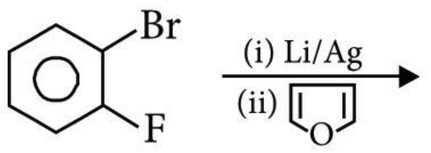
(b) 

(c) 

(d) 

Integer / Numerical Value Type

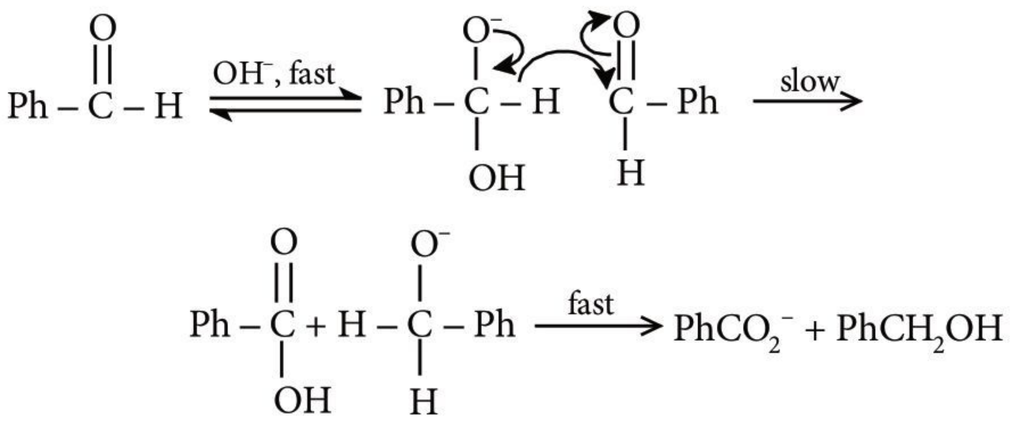
24. Electrolysis of a solution of HSO_4^- ions produces $S_2O_8^{2-}$. Assuming 75% current efficiency, what current should be employed to achieve a production rate of 1 mol of $S_2O_8^{2-}$ per hour?

25.  product (*P*). Number of rings in the product *P* is _____.

26. In both DNA and RNA, the heterocyclic base attached to which carbon of ribose sugar is _____.

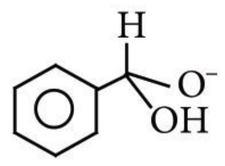
Comprehension Type

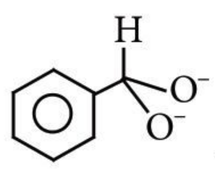
Aldehydes which do not have any α-hydrogen atoms when treated with a concentrated solution of NaOH or KOH, undergo a simultaneous oxidation and reduction forming a salt of carboxylic acid and an alcohol. This reaction is known as Cannizzaro reaction.

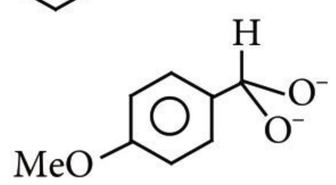


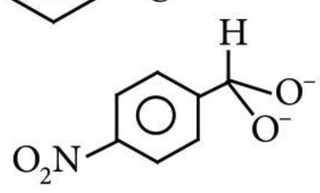
27. The Cannizzaro reaction is not given by
(a) trimethylacetaldehyde
(b) acetaldehyde
(c) benzaldehyde
(d) all of these.

28. In a Cannizzaro reaction, the intermediate that will be best hydride donor is

(a) 

(b) 

(c) 

(d) 

29. Match the complexes in column I with their properties listed in column II and select the correct option.

Column I		Column II
(A) $[Co(NH_3)_4(H_2O)_2]Cl_2$	(p)	geometrical isomers
(B) $[Pt(NH_3)_2Cl_2]$	(q)	paramagnetic
(C) $[Co(H_2O)_5Cl]Cl$	(r)	diamagnetic
(D) $[Ni(H_2O)_6]Cl_2$	(s)	metal ion with +2 oxidation state.

(a) A - p,q,s ; B - p,q,r ; C - q,r ; D - q,s
(b) A - p,q,r ; B - p ; C - q,r,s ; D - s
(c) A - p,q,r ; B - p,s ; C - q,r ; D - p,s
(d) A - p,q,s ; B - p,r,s ; C - q,s ; D - q,s

30. Match the shape listed in column I with radius ratio (minimum) listed in column II and select the correct option.

Column I		Column II
(A) plane triangular	(p)	0.225
(B) tetrahedral	(q)	0.732
(C) octahedral	(r)	0.155
(D) body centred cubic	(s)	0.414

(a) A - r ; B - s ; C - p ; D - q
(b) A - r ; B - p ; C - s ; D - q
(c) A - q ; B - s ; C - p ; D - r
(d) A - q ; B - p ; C - s ; D - r

Keys are published in this issue. Search now! ☺

SELF CHECK

No. of questions attempted .....
No. of questions correct .....
Marks scored in percentage .....

Check your score! If your score is

> 90%	EXCELLENT WORK !	You are well prepared to take the challenge of final exam.
90-75%	GOOD WORK !	You can score good in the final exam.
74-60%	SATISFACTORY !	You need to score more next time.
< 60%	NOT SATISFACTORY!	Revise thoroughly and strengthen your concepts.

PRACTICE PAPER 2022

JEE MAIN

Exam Dates
Session-1
21, 24, 25, 29 April and 1, 4 May
Session-2
24, 25, 26, 27, 28 and 29 May 2022

SECTION - A (MULTIPLE CHOICE QUESTIONS)

1. Match the Column I with Column II and select the correct option.

Column I (Element)	**Column II (Position in periodic table)**
(A) Tl	(1) *s*-block
(B) Ra	(2) *p*-block
(C) Re	(3) *d*-block
(D) Es	(4) *f*- block

(a) A – 2, B – 1, C – 3, D – 4
(b) A – 2, B – 1, C – 4, D – 3
(c) A – 1, B – 2, C – 3, D – 4
(d) A – 1, B – 2, C – 4, D – 3

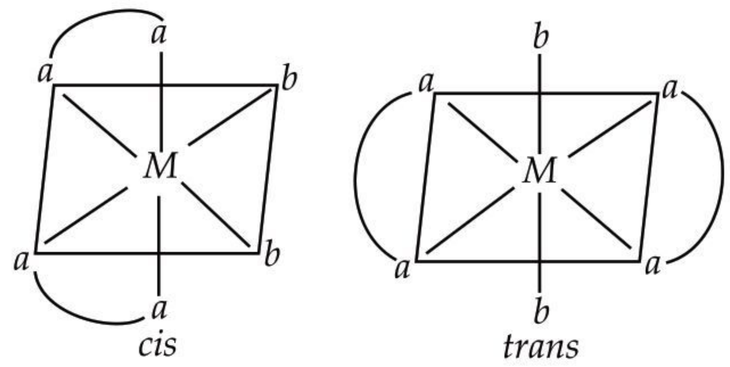
2. For the decomposition of a compound *AB* at 600 K, the following data were obtained.

$[AB]$ mol dm^{-3}	Rate of decomposition of *AB* in mol dm^{-3} s^{-1}
0.20	2.75×10^{-8}
0.40	11.0×10^{-8}
0.60	24.75×10^{-8}

The order for the decomposition of *AB* is
(a) 0 (b) 1 (c) 2 (d) 1.5

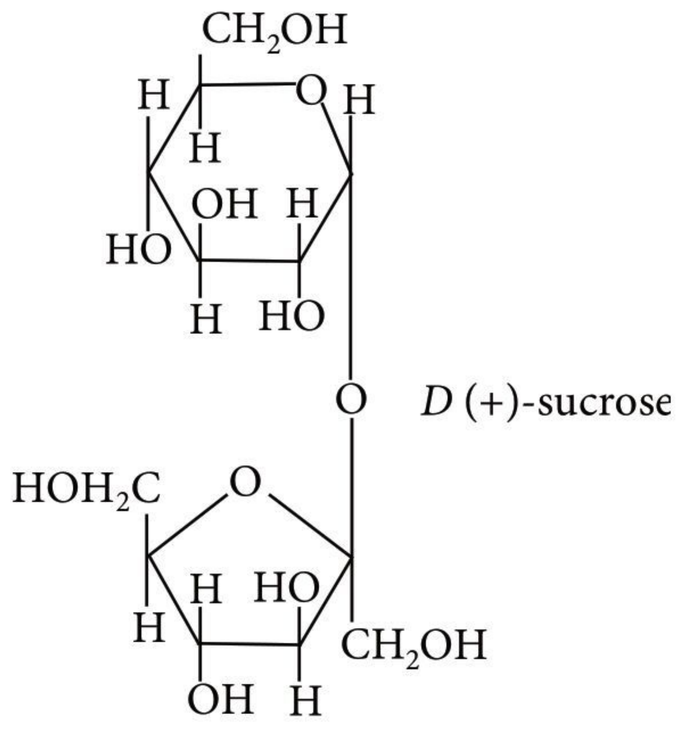
3. In the extraction of copper, the reaction which does not take place in reverberatory furnace is
(a) $2CuFeS_2 + O_2 \longrightarrow Cu_2S + 2FeS + SO_2$
(b) $2Cu_2O + Cu_2S \longrightarrow 6Cu + SO_2$
(c) $2Cu_2S + 3O_2 \longrightarrow 2Cu_2O + 2SO_2$
(d) $2FeS + 3O_2 \longrightarrow 2FeO + 2SO_2$

4. Which of the following statements is correct regarding the chirality (optical isomerism) of the *cis* and *trans* isomers of the type $M(aa)_2b_2$ (*M* stands for a metal, *a* and *b* are achiral ligands and *aa* is a bidentate ligand)?



(a) The *trans* form is achiral and optically inactive while the *cis* form is chiral and exists in two enantiomeric forms.
(b) Both the *cis* and *trans* forms are achiral and optically inactive.
(c) The *trans* form is chiral and exists in two enantiomeric forms while the *cis* form is achiral and optically inactive.
(d) Both the *cis* and *trans* forms are chiral, and each exists in two enantiomeric forms.

5. The number of chiral centres present in the following compound is



(a) 7 (b) 8
(c) 9 (d) 10

6. Which is correct about the cyclic silicate $[Si_6O_{18}]^{x-}$?
   (a) The value of x is 12.
   (b) Each Si atom is bonded with three oxygen atoms.
   (c) Each oxygen atom is bonded with two Si atoms.
   (d) All of these.

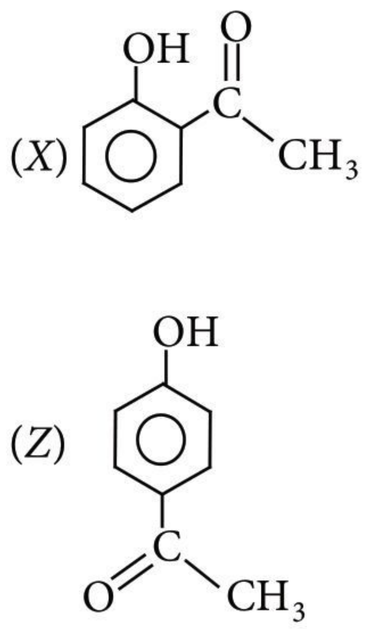
7. Which of the following is correctly arranged in order of increasing weight?
   (a) 0.625 g of Fe < 0.0105 equivalent of $H_2C_2O_4 \cdot 2H_2O$ < 6.0×10^{21} atoms of Zn < 0.006 g atom of Ag
   (b) 0.625 g of Fe < 6.0×10^{21} atoms of Zn < 0.006 g atom of Ag < 0.0105 equivalent of $H_2C_2O_4 \cdot 2H_2O$
   (c) 0.0105 equivalent of $H_2C_2O_4 \cdot 2H_2O$ < 0.006 g atom of Ag < 6.0×10^{21} atoms of Zn < 0.625 g of Fe
   (d) 0.0105 equivalent of $H_2C_2O_4 \cdot 2H_2O$ < 0.625 g of Fe < 0.006 g atom of Ag < 6.0×10^{21} atoms of Zn

8. For the electrochemical cell, $M|M^+||X^-|X$,
   $E°(M^+|M) = 0.44$ V and $E°(X|X^-) = 0.33$ V.
   From this data one can deduce that
   (a) $M + X \rightarrow M^+ + X^-$ is the spontaneous reaction.
   (b) $M^+ + X^- \rightarrow M + X$ is the spontaneous reaction.
   (c) $E°_{cell} = 0.77$ V
   (d) $E°_{cell} = -0.77$ V

9. In hexagonal close packing of sphere in three dimensions
   (a) in one unit cell there are 12 octahedral voids and all are completely inside the unit cell
   (b) in one unit cell there are six octahedral voids and all are completely inside the unit cell
   (c) in one unit cell there are six octahedral voids and of which three are completely inside the unit cell and other three are from contributions of octahedral voids which are partially inside the unit cell
   (d) in one unit cell there are 12 tetrahedral voids, all are completely inside the unit cell.

10. $Mg \xrightarrow[Heat]{Air} X + Y \xrightarrow[\substack{Colourless\\gas}]{H_2O} Z \xrightarrow{H_2O} Solution \xrightarrow{CuSO_4} (A)$ Blue coloured solution
    Substances X, Y, Z and A are respectively
    (a) Mg_3N_2, MgO, NH_3, $CuSO_4 \cdot 5H_2O$
    (b) $Mg(NO_3)_2$, MgO, H_2, $CuSO_4 \cdot 5H_2O$
    (c) MgO, Mg_3N_2, NH_3, $[Cu(NH_3)_4]SO_4$
    (d) $Mg(NO_3)_2$, MgO_2, H_2O_2, $CuSO_4 \cdot 5H_2O$

11. The correct acidic strength order is



   (a) $X > Z > W > Y$ (b) $Z > X > Y > W$
   (c) $W > Z > X > Y$ (d) $X > Z > Y > W$

12. **Statement-1 :** Equivalent weight of Cu in CuO is 63.6 and in Cu_2O is 31.8.
    Statement-2 : Equivalent weight of an element $= \frac{\text{Atomic weight of the element}}{\text{Valency of the element}}$
    (a) Statement-1 is true, statement-2 is true; statement - 2 is a correct explanation for statement-1.
    (b) Statement-1 is true, statement-2 is true; statement-2 is not a correct explanation for statement-1.
    (c) Statement-1 is true, statement-2 is false.
    (d) Statement-1 is false, statement-2 is true.

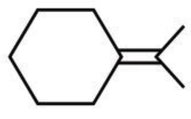
13. Match the following questions

Column-I		Column-II	
A.	Wurtz-Fittig reaction	p.	$C_2H_5OC_2H_5$
B.	Etard's reaction	q.	$C_6H_5CH_3$
C.	Friedel-Craft's reaction	r.	C_6H_5CHO
D.	Williamson's synthesis	s.	$C_6H_5COCH_3$

    The correct option is
    (a) A → q ; B → r ; C → q, s ; D → p
    (b) A → q ; B → r ; C → p, s ; D → q
    (c) A → r ; B → q, r ; C → r, s ; D → q
    (d) A → r ; B → q ; C → p, s ; D → p

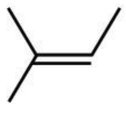
14. In which case, size of chromium is largest?
    (a) $K_2Cr_2O_7$ (b) CrO_2Cl_2
    (c) $CrCl_3$ (d) All have same size.

15. The relative rate of catalytic hydrogenation of following alkenes is

I. 

II. 

III. 

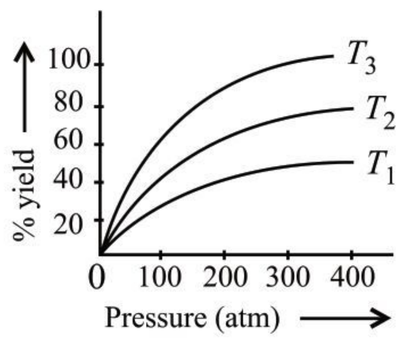
IV. 

(a) I > IV > III > II (b) II > III > IV > I
(c) III > IV > I > II (d) II > IV > I > III

16. In an irreversible process taking place at constant T and P and in which only pressure-volume work is being done, the change in Gibbs' free energy (dG) and change in entropy (dS), satisfy the criteria is
(a) $(dS)_{V, E} < 0, (dG)_{T, P} < 0$
(b) $(dS)_{V, E} > 0, (dG)_{T, P} < 0$
(c) $(dS)_{V, E} = 0, (dG)_{T, P} = 0$
(d) $(dS)_{V, E} = 0, (dG)_{T, P} > 0$

17. The pressure in a bulb dropped from 2000 to 1500 mm of mercury in 47 minutes when the contained oxygen leaked through a small hole. The bulb was then completely evacuated. A mixture of oxygen and another gas of molecular weight 79 in the molar ratio of 1 : 1 at a total pressure of 4000 mm of mercury was introduced. Find the molar ratio of the two gases remaining in the bulb after a period of 74 minutes.
(a) 2.532 : 1 (b) 1.236 : 1
(c) 1 : 1.54 (d) 3 : 2

18. The preparation of ammonia by Haber's process is an exothermic reaction. If the process follows the following temperature-pressure relationship for its % yield, then for temperatures T_1, T_2 and T_3 the correct option is
(a) $T_3 > T_2 > T_1$
(b) $T_1 > T_2 > T_3$
(c) $T_1 = T_2 = T_3$
(d) nothing could be predicted.



19. Match Column-I with Column-II and select the correct answer.

Column-I	Column-II
(A) Fluorides affected	(i) Photosynthesis is
(B) SO_2	(ii) Eutrophication
(C) Cyanides, CO_2, H_2S	(iii) Consumes dissolved oxygen
(D) Nitrate and sulphate nutrients	(iv) Bad effects on teeth and bones
	(v) pH of water changes and becomes toxic to aquatic animals

(a) A-(i); B-(ii); C-(iii); D-(iv)
(b) A-(iv); B-(ii); C-(iii); D-(i)
(c) A-(iv); B-(i); C-(v); D-(ii)
(d) A-(iv); B-(i); C-(ii); D-(v)

20. Which of the following sets of reactants is used for preparation of paracetamol from phenol?
(a) HNO_3, H_2/Pd, $(CH_3CO)_2O$
(b) H_2SO_4, H_2/Pd, $(CH_3CO)_2O$
(c) $C_6H_5N_2Cl$, $SnCl_2$ / HCl, $(CH_3CO)_2O$
(d) Br_2 / H_2O, Zn / HCl, $(CH_3CO)_2O$

SECTION - B (NUMERICAL TYPE QUESTIONS)

Attempt any 5 questions out of 10.

21. An optically active compound (A), $C_3H_7O_2N$ forms a hydrochloride but dissolves in water to give a neutral solution. On heating with sodalime, (A) yields C_2H_7N(B). Both (A) and (B) react with $NaNO_2$ and HCl, the former yielding a compound (C) $C_3H_6O_3$, which on heating is converted to (D), $C_6H_8O_4$ while the latter yields (E), C_2H_6O. The type of carbon to which N is attached to in (A) is _____.

22. What is the total number of orbitals associated with the principal quantum number $n = 3$?

23. Relative decrease in vapour pressure of an aqueous glucose dilute solution is found to be 0.018. Hence, elevation in boiling point (in K) is _____.
Given : 1 molal aqueous urea solution boils at 100.54°C at 1 atm pressure.)

24. The number of geometrical isomers of 2,4-hexadiene is _____.

25. The oxidation state of central atom in the complex $[Co(NH_3)_4ClNO_2]$ is _____.

26. The increase in volume of air, when temperature of 600 mL of it, is increased from 27°C to 47°C under constant pressure, is _____ mL.

27. The standard reduction potentials of Cu^{2+}/Cu and Cu^{2+}/Cu^{+} are 0.337 V and 0.153 V respectively. The standard electrode potential of Cu^{+}/Cu half cell is _____ V.

28. 0.50 g of an organic compound was Kjeldahlised and the NH_3 evolved was absorbed in 50 mL of 0.5 M H_2SO_4. The residual acid required 60 cm^3

of 0.5 M NaOH. The percentage of nitrogen in the organic compound is _____.

29. What is the $[OH^-]$ (in M) in the final solution prepared by mixing 20.0 mL of 0.050 M HCl with 30.0 mL of 0.10 M $Ba(OH)_2$?

30. A dihalogen derivative(A) of a hydrocarbon having two C-atoms react with alc. KOH and forms another hydrocarbon which gives a red ppt. with ammoniacal Cu_2Cl_2. Compound (*A*) gives an aldehyde when treated with aq. KOH. The IUPAC name of (*A*) is *x*, *y* -dichloroethane. The value of $(x + y)$ is _____.

SOLUTIONS

1. (a) :

Element	Block
Tl	*p*-block (2)
Ra	*s*-block (1)
Re	*d*-block (3)
Es	*f*-block (4)

2. (c) : Let rate equation be, rate $= k[AB]^n$

Case (i) $2.75 \times 10^{-8} = k[0.2]^n$

Case (ii) $11 \times 10^{-8} = k[0.40]^n$

Case (iii) $24.75 \times 10^{-8} = k[0.6]^n$

Divide (ii) by (i)

$$\frac{11\times10^{-8}}{2.75\times10^{-8}} = \frac{[0.40]^n}{[0.2]^n}$$

$\Rightarrow 2^n = 4 \Rightarrow n = 2 \therefore$ Order of reaction = 2

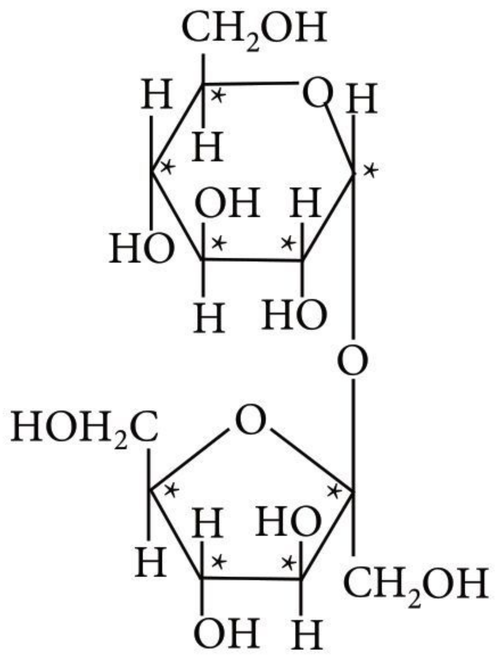
3. (b) : Excess of silica is absorbed by basic lining of the bessemer converter and part of cuprous sulphide is oxidised to cuprous oxide which combines with remaining cuprous sulphide to form free copper metal.

$2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$

$2Cu_2O + Cu_2S \rightarrow 6Cu + SO_2$

4. (a) : *Cis* is optically active and *trans* is optically inactive due to presence to plane of symmetry.

5. (c) :



6. (a) : General formula of cyclic silicates is $[Si_nO_{3n}]^{2n-}$.

7. (b) : 0.625 g Fe

0.0105 eq. of $H_2C_2O_4{\cdot}2H_2O = 0.0105 \times 63$

$= 0.66$ g (Eq. wt. = 63)

6×10^{21} atoms of Zn $= \frac{6\times10^{21}}{6.023\times10^{23}} \times 65 = 0.647$ g

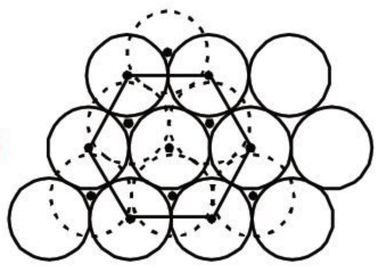
0.006 g atom of Ag $= 0.006 \times 108 = 0.648$ g

$\therefore$ Increasing order of weight :

Fe < Zn < Ag < $H_2C_2O_4{\cdot}2H_2O$

8. (b) : $M^+ + X^- \rightarrow M + X$ is spontaneous because for the cell represented by $M|M^+ \,||\, X^-|X$, the value of $E°$ is positive *i.e.* (0.44 – 0.33) V = 0.11 V.

9. (b) :



hcp = *ABABAB* .... pattern is repeated

The dots are representing tetrahedral voids.

Number of tetrahedral voids $= 3+1+\frac{1}{3}\times6 = 6$

So, in one complete unit cell total tetrahedral voids are 12, out of which 8 are completely inside but rest are shared by other unit cells.

Octahedral voids = 3

So, total octahedral voids = 6 = all are completely inside.

10. (c) :

$$5Mg + \underbrace{O_2 + N_2}_{\text{Air}} \longrightarrow \underset{(X)}{MgO} + \underset{(Y)}{Mg_3N_2}$$

$$Mg_3N_2 + 6H_2O \longrightarrow 3Mg(OH)_2 + \underset{(Z)}{2NH_3}$$

$$NH_3 + H_2O \longrightarrow \underset{\text{(Solution)}}{NH_4OH}$$

$$CuSO_4 + 4NH_4OH \longrightarrow \underset{(A)}{[Cu(NH_3)_4]\,SO_4} + 4H_2O$$

11. (b) : The acidity of phenols increases strongly due to *–I*, *–M* group on their *ortho* and *para* positions. But *para* substituted phenol is more acidic than *ortho*

MONTHLY TEST DRIVE CLASS XI ANSWER KEY

1.	(c)	**2.**	(a)	**3.**	(d)	**4.**	(b)	**5.**	(a)
6.	(a)	**7.**	(d)	**8.**	(c)	**9.**	(c)	**10.**	(d)
11.	(d)	**12.**	(c)	**13.**	(b)	**14.**	(c)	**15.**	(a)
16.	(a)	**17.**	(b)	**18.**	(d)	**19.**	(d)	**20.**	(a,b)
21.	(a,b,d)	**22.**	(a,b)	**23.**	(a,c,d)	**24.**	(964)	**25.**	(5)
26.	(7)	**27.**	(a)	**28.**	(c)	**29.**	(b)	**30.**	(d)

substituted due to intermolecular hydrogen bonding in the *ortho* substituted phenol.

12.(d) : Eq. wt. of Cu in CuO =

$$\frac{63.6}{2} = \frac{\text{(at. wt.)}}{\text{(valency of Cu = 2)}} = 31.8$$

Eq. wt. of Cu in $Cu_2O = \frac{63.6}{1} = 63.6$ (valency of Cu = 1)

13.(a)

14.(c) : $K_2Cr_2O_7 \Rightarrow 2(+1) + 2x + 7(-2) = 0$

$\Rightarrow +2 + 2x - 14 = 0 \Rightarrow x = +6, Cr^{6+}$

$CrO_2Cl_2 \Rightarrow x + 2(-2) + 2(-1) = 0 \Rightarrow x = +6, Cr^{6+}$

$CrCl_3 \Rightarrow x + 3(-1) = 0 \Rightarrow x = +3. Cr^{3+}$ (largest size)

$Z = 24$, $e = 18$ } Z/e is high. High nuclear charge therefore small size.

$Z = 24$, $e = 21$ } Z/e is low. Low nuclear charge therefore large size.

15.(b) : More highly substituted alkenes are not adsorbed on metal catalyst effectively so are not readily reduced.

16.(b) : For an irreversible spontaneous process $(dS)_{V,E} > 0$ and $(dG)_{T,P} < 0$.

17.(b) : The molar ratio of oxygen and the other gas in the evacuated bulb = 1 : 1 and the total pressure of the gas mixture is 4000 mm, hence the partial pressure of each gas is 2000 mm. The drop in the pressure of oxygen after 74 minutes

$$= \frac{(2000-1500)\times 74}{47} = 787.2 \text{ mm of Hg}$$

$\therefore$ After 74 minutes, the pressure of oxygen
= 2000 – 787.2 = 1212.8 mm of Hg

Let the rate of diffusion of other gas be r_n, then

$$\frac{r_n}{r_{O_2}} = \sqrt{\frac{32}{79}}$$

$\therefore$ Drop in pressure for the other gas

$$= 787.2 \times \sqrt{\frac{32}{79}} = 501.01 \text{ mm of Hg}$$

$\therefore$ Pressure of the other gas after 74 minutes
= 2000 – 501.01 mm = 1498.99 mm of Hg

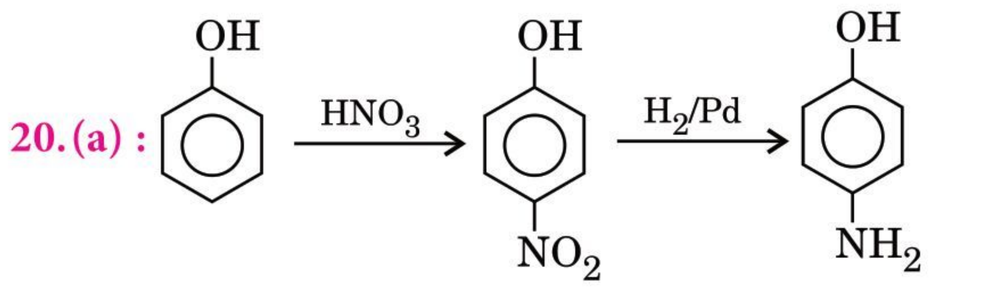
$$\text{Molar ratio} = \frac{\text{Moles of unknown gas}}{\text{Moles of } O_2}$$

$$= \frac{1498.99}{1212.8} = 1.236:1$$

18.(b) : For exothermic reactions as temperature increases yield decreases thus, $T_1 > T_2 > T_3$.

19.(c)

20.(a) :



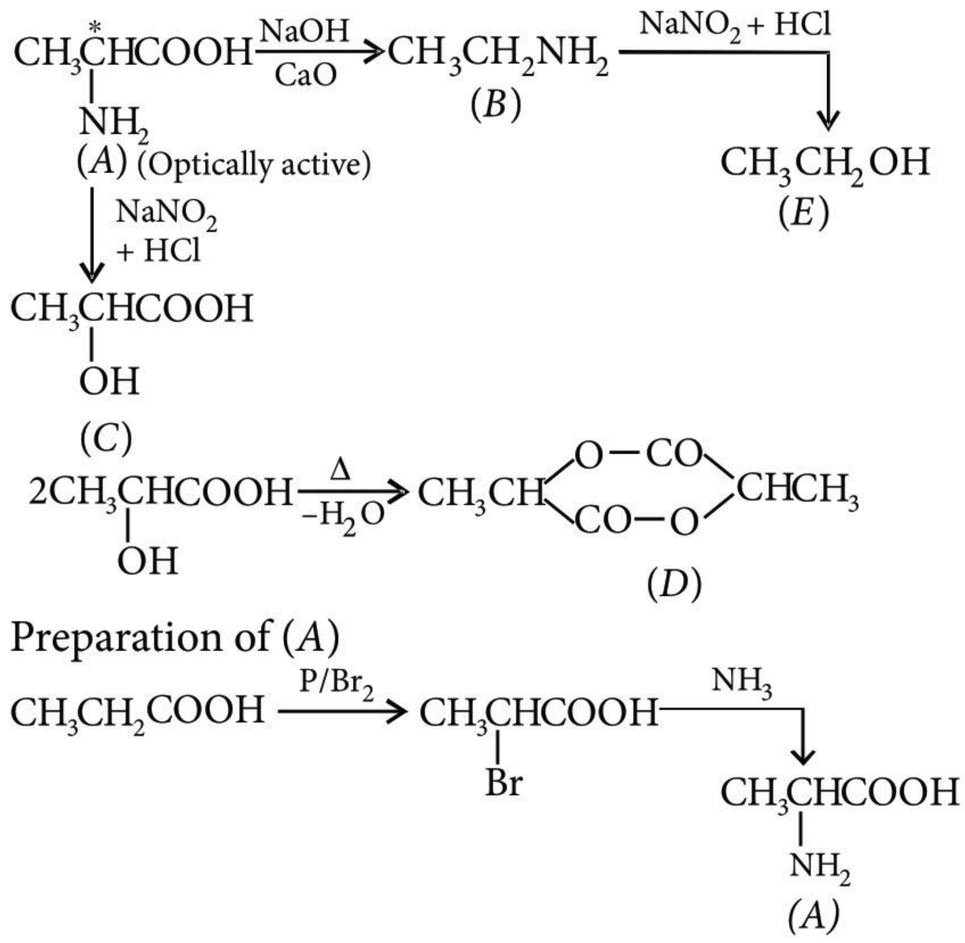
Paracetamol

21.(2) : Degree of unsaturation of $(A) = 1$

Since (A) forms hydrochloride and dissolves in water to give a neutral solution, it contains both a basic and an acidic functional group. It is likely to be an amino acid as the molecular formula contains one N and 2 O-atoms. On decarboxylation it forms an amine (B).

Degree of unsaturation of $(B) = 0$

Therefore, (B) is a saturated amine. (B) reacts with $NaNO_2$ and dilute HCl forming (E) C_2H_5OH. Thus, (B) is $CH_3CH_2 — NH_2$. (A) also reacts with $NaNO_2$ and dilute HCl forming (C), a hydroxy acid which forms a cyclic diester on heating.



Preparation of (A)

Thus in (A), the N of $-NH_2$ group is attached to a 2° C-atom.

22.(9) : Possible values of $l = 0 \ldots (n-1)$

if $n = 3$; $l = 0, 1, 2$

3*s*-subshell,	$l = 0$,	1 orbital
3*p*-subshell,	$l = 1$,	3 orbitals
3*d*-subshell,	$l = 2$,	5 orbitals

Total 9 orbitals are associated with $n = 3$.

23. (0.55 K) : $\frac{\Delta p}{p^\circ} = 0.018 = x_{\text{glucose}}$

For aqueous urea solution,

$\Delta T_b = T_b - T_b^\circ = 100.54 - 100 = 0.54\ ^\circ\text{C}$

$\Delta T_b = K_b\, m$

$0.54 = K_b \times 1 \implies K_b = 0.54\ ^\circ\text{C kg mol}^{-1}$

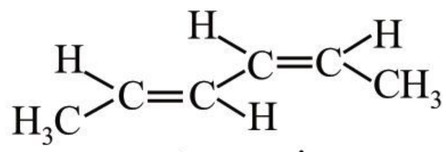
To calculate elevation in boiling point of aqueous glucose solution,

$\Delta T_b = K_b \cdot m$

$= 0.54 \cdot \text{m} = 0.54 \times \frac{n_{\text{glucose}}}{w_{\text{water (in g)}}} \times 1000$

$= \frac{0.54 \times 0.018}{(0.982 \times 18)} \times 1000 = 0.54 \times 1.018 = 0.549\ \text{K}$

24. (3) : 2,4-hexadiene can have the following possible geometrical isomeric structures.

(i) 

trans, cis

PUBLIC NOTICE JEE MAIN 2022

The Department of Higher Education, Ministry of Education, Government of India has entrusted the responsibility of conducting the Joint Entrance Examination (JEE Main) to the NTA from 2019 onwards.

The Joint Entrance Examination **(JEE (Main)** comprises **two papers. Paper 1** is conducted for admission to Undergraduate Engineering Programs **(B.E./B. Tech)** at NIT's, IITs, other Centrally Funded Technical Institutions (CFTIs), Institutions/Universities funded/recognized by participating State Governments. It is also an eligibility test for JEE (Advanced), which is conducted for admission to IITs. **Paper 2** is conducted for admission to **B. Arch and B. Planning** courses in the Country.

The JEE (Main) - 2022 will be conducted in **02 (two) sessions** for admissions in the next academic session (2022-23). The details are given below :

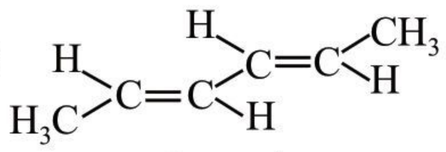
Paper	Subjects	Section A	Section B	Mode of Examination	Timing of The Examination (IST)	
					First Shift	Second Shift
Paper 1 (B.E. / B. Tech.)	Mathematics	20*	10*	**Computer Based Test (CBT) mode**	**9:00 a.m. to 12:00 p.m.**	**3:00 p.m. to 6:00 p.m.**
	Physics	20*	10*			
	Chemistry	20*	10*			
	Total	**90**				
Paper 2A (B. Arch.)	Mathematics - Part I	20*	10*	**Computer Based Test (CBT) mode except** Drawing Test (Part-III) in pen and paper (offline) mode, to be attempted on drawing sheet of A4 size	**9:00 a.m. to 12:00 p.m.**	**3:00 p.m. to 6:00 p.m.**
	Aptitude Test - Part II	50				
	Drawing Test - Part III	02				
	Total	**82**				
Paper 2B (B. Planning)	Mathematics - Part I	20*	10*	**Computer Based Test (CBT) mode**	**3:00 p.m. to 6:00 p.m.**	
	Aptitude Test - Part II	50				
	Planning - Part III	25				
	Total	**105**				

*For Paper 1 and Part-I of Paper 2, each Subject will have **two sections.** Section A will be of Multiple-Choice Questions (MCQs) and Section B will contain Questions whose answers are to be filled in as a numerical value. In Section B, candidates have to attempt any **05 (five) questions out of 10. There will be negative marking for both Section A and Section B.** For each question in Section B, **enter the correct integer value** of the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer. **For Section B, the answer should be rounded off to the nearest Integer.**

Medium of the Question Papers: Drawing from the National Education Policy (NEP), the JEE (Main) 2022 will be conducted in *Assamese, Bengali, Kannada, Malayalam, Marathi, Odia, Punjabi, Tamil, Telugu, Urdu in addition to Hindi, English and Gujarati.*

Dates of Examinations :

Session-1	Session-2
21, 24, 25, 29 April and 1, 4 May	24, 25, 26, 27, 28 and 29 May 2022

(ii) 

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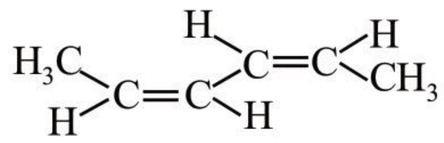
(iii) 

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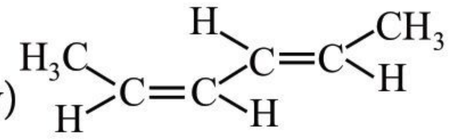
(iv) 

cis, trans

Structures (i) and (iv) are identical, thus there are a total of 3 geometrical isomers of 2,4 hexadiene.

25.(2) : Let the oxidation state of Co be x.

$[Co(NH_3)_4ClNO_2] : x + 4 \times 0 + 1 \times (-1) + 1 \times (-1) = 0$

$x - 2 = 0 \quad \Rightarrow \quad x = +2$

26.(40) : $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$$\text{So, } V_2 = \frac{T_2}{T_1} \cdot V_1 = \frac{320}{300} \times 600 \text{ mL} = 640 \text{ mL}$$

So, increase in volume = (640 – 600) = 40 mL

27.(0.52) : (i) $Cu^{2+} + 2e^- \rightarrow Cu$, $E_1^\circ = 0.337$ V,

$\Delta G_1^\circ = -n_1 F E_1^\circ$ and $n_1 = 2$

(ii) $Cu^{2+} + e^- \rightarrow Cu^+$, $E_2^\circ = 0.153$ V,

$\Delta G_2^\circ = -n_2 F E_2^\circ$ and $n_2 = 1$

Target reaction (iii) $Cu^+ + e^- \rightarrow Cu$, $E_3^\circ = ?$, $\Delta G_3^\circ = ?$

So, target equation = (i) – (ii)

$\Delta G_3^\circ = \Delta G_1^\circ - \Delta G_2^\circ$

$E_3^\circ = -1 \{-2 \times 0.337 + 0.153\}$ V = 0.521 V

28.(56) : Vol. of 1 M H_2SO_4 taken = $50 \times 0.5 = 25$ mL

Vol. of 1 M NaOH used for neutralisation of the residual acid = $60 \times 0.5 = 30$ mL

Since one mole of H_2SO_4 neutralises 2 moles of NaOH.

$\therefore$ Vol. of 1 M H_2SO_4 left unused = 30/2 = 15 mL

Vol. of 1 M H_2SO_4 used = (25 – 15) = 10 mL

Normality = $n \times M = 2 \times 1 = 2$ N

$$\text{So, \% N} = \frac{1.4 \times N \times V}{w} = \frac{1.4 \times 10 \times 2}{0.5} = 56$$

29.(0.1) : Millimoles of H^+ produced = $20 \times 0.05 = 1$

Millimoles of OH^- produced = $30 \times 0.1 \times 2 = 6$

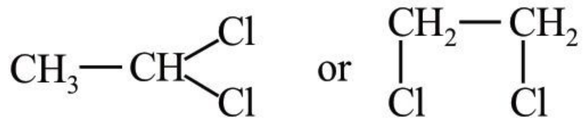
($\because$ Each $Ba(OH)_2$ gives $2OH^-$.)

$\therefore$ Millimoles of OH^- remaining in solution = 6 – 1 = 5

Total volume of solution = 20 + 30 = 50 mL

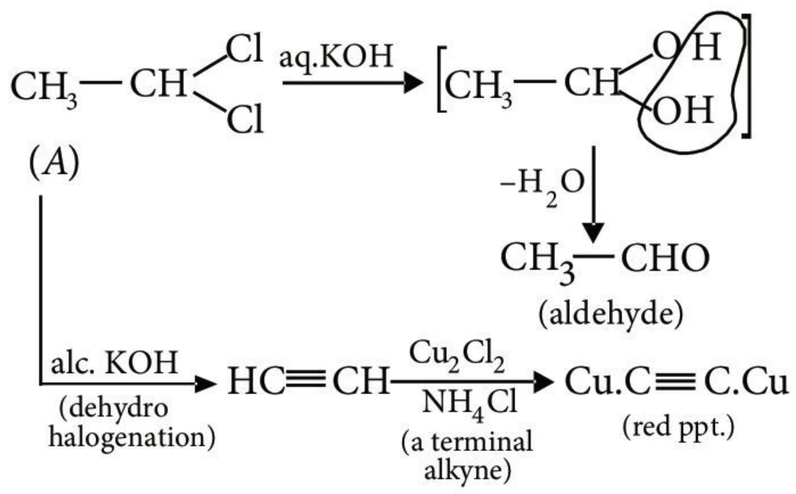
$$\therefore \quad [OH^-] = \frac{5}{50} = 0.1 \text{ M}$$

30.(2) : Since compound (A) is a dihalogen derivative of a hydrocarbon having two carbon atoms, hence it may be one of the two.



(i) or (ii)

Only (i) gives an aldehyde with aq. KOH, (ii) gives 1,2-diol, hence correct structure of A is (i).



Hence, A is $CH_3 - CHCl_2$, that is, 1,1-dichloroethane.

CONCEPT MAP

CHEMISTRY VITALS

Physical Chemistry

The Solid State

- **Density of unit cell :** $d = \dfrac{Z \times M}{a^3 \times N_A}\ g\ cm^{-3}$
- **Total no. of atoms per unit cell :**

sc	*bcc*	*fcc*
$8 \times \frac{1}{8} = 1$	$8 \times \frac{1}{8} + 1 \times 1 = 2$	$8 \times \frac{1}{8} + 6 \times \frac{1}{2} = 4$

- **Relation between *d*, *a* and *r***

sc	$r = \frac{d}{2} = \frac{a}{2}$ since $d = a$
fcc	$r = \frac{d}{2} = \frac{a}{2\sqrt{2}}$ since $d = \frac{a}{\sqrt{2}}$
bcc	$r = \frac{d}{2} = \frac{\sqrt{3}a}{4}$ since $d = \frac{\sqrt{3}a}{2}$

Solutions

- **Expression for concentration of a solution :**

$$M = \frac{w_2 \times 1000}{M_2 \times V_{(in\ mL)}};\ N = \frac{w_2 \times 1000}{E_2 \times V_{(in\ mL)}};\ m = \frac{w_2 \times 1000}{M_2 \times w_{1(in\ g)}}$$

$$x_2 = \frac{n_2}{n_1 + n_2},\ x_1 = \frac{n_1}{n_1 + n_2};\ ppm = \frac{w_2}{M_{soln.}} \times 10^6$$

- **Henry's law :** $p = K_H \cdot x$
- **For liquid solutions :** $p_A = x_A \times p_A^\circ;\ p_B = x_B \times p_B^\circ;$ $P_{total} = p_A + p_B;\ y_A = p_A/(p_A + p_B),\ y_B = 1 - y_A$
- **Modified colligative properties :** $\Delta T_b = iK_b \times m$

$$\Delta T_f = iK_f \times m;\ \pi = i\frac{n}{V}RT;\ \frac{p^\circ - p_s}{p^\circ} = ix_2$$

$$\alpha_{(disso.)} = \frac{i-1}{n-1};\ \alpha_{(asso.)} = (1-i)\frac{n}{n-1};\ i = \frac{M_c}{M_o}$$

Electrochemistry

- $R = \frac{V}{I};\ G = \frac{1}{R};\ \rho = R\frac{a}{l};\ \kappa = G \times \frac{l}{a}$
- $\Lambda_{eq} = \kappa \times V = \kappa \times 1000/N;\ \Lambda_m = \kappa \times V = \kappa \times 1000/M$
- $\Lambda_m^c = \Lambda_m^\infty - A\sqrt{c};\ \Lambda_{eq}^\infty = \frac{1}{x} \cdot \lambda_c^\infty + \frac{1}{y} \cdot \lambda_a^\infty;\ \Lambda_m^\infty = x\lambda_c^\infty + y\lambda_a^\infty$
- $\alpha = \dfrac{\Lambda_m^c}{\Lambda_m^\infty};\ \Delta G^\circ = -nFE_{cell}^\circ = -RT\ln K_c$
- $E_{cell} = E_{cell}^\circ - \dfrac{0.0591}{n}\log\dfrac{1}{[M^{n+}]};\ E_{cell}^\circ = \dfrac{0.0591}{n}\log K_c$

Chemical Kinetics

- **Expressions for different orders :**

Rate law	Integrated rate law	Half-life period
$Rate = k[A]^0$ [Zero order]	$[A]_t = -kt + [A]_0$	$t_{1/2} = [A]_0/2k$
$Rate = k[A]^1$ [1st order]	$\ln[A]_t = -kt + \ln[A]_0$	$t_{1/2} = 0.693/k$
$Rate = k[A]^2$ [2nd order]	$1/[A]_t = kt + 1/[A]_0$	$t_{1/2} = 1/k[A]_0$
$Rate = k[A]^n$ [nth order]	$(n-1)kt = 1/[A]^{n-1} - 1/[A]_0^{n-1}$	$t_{1/2} = \dfrac{2^{n-1}-1}{k(n-1)[A]_0^{n-1}}$

- **Arrhenius equation :** $k = Ae^{-E_a/RT};\ \log\dfrac{k_2}{k_1} = \dfrac{E_a}{2.303\,R}\left[\dfrac{T_2 - T_1}{T_1T_2}\right]$
- **Collision theory :** $k = PZe^{-E_a/RT}$

  where, P = steric factor ; Z = collision frequency

Surface Chemistry

- **Freundlich adsorption isotherm :** $\dfrac{x}{m} = kP^{1/n}$
- **Langmuir adsorption isotherm :** $\dfrac{x}{m} = \dfrac{aP}{1+bP}$
- **Hardy-Schulze rule :** Coagulation power for

  -vely charged sols : $Al^{3+} > Ba^{2+} > Na^+$

  +vely charged sols : $[Fe(CN)_6]^{4-} > PO_4^{3-} > SO_4^{2-} > Cl^-$

General Principles and Processes of Isolation of Elements

- **Thermodynamic principles of metallurgy :** For a reaction to occur, ΔG should be -ve. A reaction with + ve ΔG can be made to occur if it is coupled with another reaction having a large -ve ΔG, so that the net ΔG of both the reactions is -ve. *Ellingham Diagram* : Plots of $\Delta_f G^\circ$ *vs* T for formation of oxides. These help in predicting the feasibility of thermal reduction of an ore.
  - For most of the reactions of formation of $M_xO_{(s)}$, slope = +ve, because ΔG° increases with rise in T.
  - Each curve is a straight line except when phase changes take place (solid → liquid, liquid → gas).
  - Metal oxide placed higher in the diagram can be reduced by the metal placed lower.

Inorganic Chemistry

The *p*-Block Elements

- **Group 15 (Nitrogen family) :**
  - *Bond angle, Thermal stability and Basic strength :* $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$
  - *B.pt.* : $PH_3 < AsH_3 < NH_3 < SbH_3 < BiH_3$
  - *Reducing nature* : $NH_3 < PH_3 < AsH_3 < SbH_3 < BiH_3$

  Group 16 (Oxygen family) :
  - *Bond angle and Thermal stability :* $H_2O > H_2S > H_2Se > H_2Te$
  - *Acidic character and Reducing nature :* $H_2O < H_2S < H_2Se < H_2Te$
- **Group 17 (Halogen family) :**
  - *Oxidizing power* : $F_2 > Cl_2 > Br_2 > I_2$
  - *M.pt.* : HI > HF > HBr > HCl
  - *B.pt.* : HF > HI > HBr > HCl
  - *Bond length, Acidic strength and Reducing nature :* HF < HCl < HBr < HI
- **Group 18 (Noble gases) :**
  - *M.pt., B.pt., Ease of liquefaction, Solubility, Adsorption and Polarizability* : He < Ne < Ar < Kr < Xe
  - *Thermal conductivity* : He > Ne > Ar > Kr > Xe

The *d*- and *f*-Block Elements

- ***d*-block elements :** $(n-1)d^{1-10}\ ns^{0-2}$
  - Generally atomic radii decreases with increase in atomic number.
  - Atomic radii of the pairs are almost same because of Lanthanoid contraction. [Zr-Hf, Nb-Ta, Mo-W, Ag-Au]
  - They show variable oxidation states .
  - They form complexes, interstitial compounds and alloys.
  - They also act as catalysts.
- ***f*-block elements :** $(n-2)f^{1-14}(n-1)d^{0-1}ns^2$
  - $La(OH)_3$ to $Lu(OH)_3$: Basicity decreases
  - La^{3+} to Lu^{3+} : Tendency to form complexes increases

Coordination Compounds

- **Spectrochemical series :** $I^- < Br^- < SCN^- < Cl^- < S^{2-} < F^- < OH^- < C_2O_4^{2-} < H_2O < NCS^- < edta^{4-} < NH_3 < en < NO_2^- < CN^- < CO$
- Magnetic moment, $\mu = \sqrt{n(n+2)}$ B.M.; $\Delta_t = 4/9\Delta_o$
- CFSE $= (-0.4x + 0.6y)\Delta_o$ where, x = no. of electrons in t_{2g} orbitals, y = no. of electrons in e_g orbitals.

Amines

- **Basic nature :** Aliphatic amine > NH_3 > aromatic amine
  - $3^\circ > 2^\circ > 1^\circ > NH_3$ [in gas phase/in non-aq. solvent]
  - $2^\circ > 1^\circ > 3^\circ > NH_3$ [in aq. phase, only $-CH_3$ subs. amines]
  - $2^\circ > 3^\circ > 1^\circ > NH_3$ [in aq. phase, for $-C_2H_5$ or higher subs. amines]
- **Hinsberg's test :**

  $C_6H_5SO_2Cl$ + 1° + 2° + 3° amines
  - → Clear solution $\xrightarrow{KOH}$ Soluble salt [For 1° amine]
  - → PPt. $\xrightarrow{KOH}$ Insoluble [For 2° amine]
  - → No reaction [For 3° amine]

Organic Chemistry

Haloalkanes and Haloarenes

- **Reactivity order :** *RI* > *R*Br > *R*Cl
  - S_N1 *reaction* : 3° > 2° > 1°
  - S_N2 *reaction* : 1° > 2° > 3°
- **Elimination reaction :**
  - *E*1 : Reactivity of alkyl halides : 3° > 2° > 1°.
  - *E*2 : Favourable → 1° alkyl halide in presence of strong base.

Alcohols, Phenols and Ethers

- **Acidity :** Phenols > water > 1° alcohol > 2° alcohol > 3° alcohol
- **Distinction test of alcohols :**

Alcohol	Dichromate (Oxidation) test	Victor Meyer's test	Lucas test
1°	Acid (Orange solution becomes green)	Blood red colour	No turbidity
2°	Ketone (Orange solution becomes green)	Blue colour	Turbidity in 5 minutes
3°	No reaction	Colourless	Turbidity immediately

- **Distinction test of phenol :**

Test	Observation
$FeCl_3$ test	Violet colour
$Br_2 - H_2O$ test	White ppt.
Liebermann's nitroso test ($NaNO_2$ + conc. H_2SO_4)	Deep green/blue colour which changes into red on dilution.

Aldehydes, Ketones and Carboxylic Acids

- **Reactivity order towards nucleophilic substitution reactions :** HCHO > *R*CHO > PhCHO > *R*COR > *R*COPh > PhCOPh
- **Distinction test of aldehydes & ketones :**

Test	Aldehydes	Ketones
Fehling's solution	Red ppt.	No ppt.
Tollens' reagent	Silver mirror	No ppt.

- **Distinction test of carboxylic acids and phenol :**

Test	Carboxylic acids	Phenols
$NaHCO_3$	Brisk effervescence of CO_2 gas	No reaction
$FeCl_3$	Buff coloured ppt.	Violet colour

Biomolecules

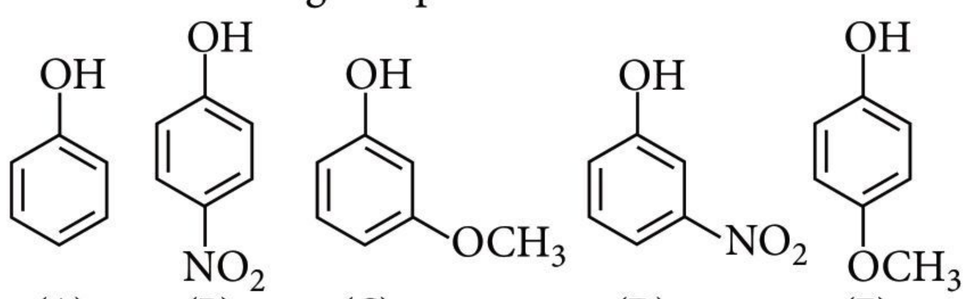
- **Reducing sugars :** All monosaccharides. Few disaccharides such as maltose and lactose.
- **Non reducing sugars :** All polysaccharides. Few disaccharides like sucrose.
- **Isoelectric point :** The isoelectric point of an amino acid is defined as the point at which the amino acid corries no net electrical charge.

PRACTICE PAPER

NEET 2022

SECTION - A

1. Mark the correct order of decreasing acid strength of the following compounds.

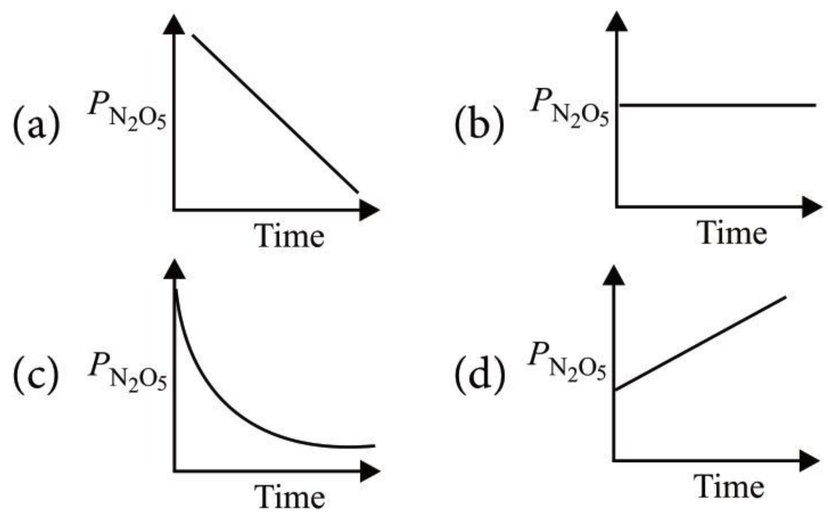


(A) (B) (C) (D) (E)

(a) E > D > B > A > C (b) B > D > C > A > E

(c) D > E > C > B > A (d) E > D > C > B > A

2. Which of the following graphs will show the variation of partial pressure of N_2O_5 decomposing into NO_2 and O_2 following the first order kinetics?



3. Which of the following statements regarding an orbital is correct?

(a) an orbital is a definite trajectory around the nucleus in which electron can move

(b) an orbital always has spherical trajectory .

(c) it is the region around the nucleus where there is 90 to 95% probability of finding all electrons in an atom.

(d) an orbital is characterized by the three distinct quantum numbers n, l and m.

4. The shape and hybridisation of some xenon oxyfluorides are given. Choose the wrong set.

(a) $XeOF_2$ -T-Shape-sp^3d

(b) $XeOF_4$ - Square pyramidal-sp^3d^2

(c) XeO_2F_2 -Distorted trigonal bipyramidal-sp^3d

(d) XeO_3F_2 - Octahedral - sp^3d

5. Phosphorus pentachloride dissociates as follows, in a closed reaction vessel, $PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$ If total pressure at equilibrium of the reaction mixture is P and degree of dissociation of PCl_5 is x, the partial pressure of PCl_3 will be

(a) $\left(\frac{x}{x+1}\right)P$ (b) $\left(\frac{2x}{1-x}\right)P$

(c) $\left(\frac{x}{x-1}\right)P$ (d) $\left(\frac{x}{1-x}\right)P$

6. In spinel structure, O^{2-} ions are cubic-closed packed whereas 1/8th of the tetrahedral holes are occupied by A^{2+} cations and 1/2 of the octahedral holes are occupied by cations B^{3+}. The general formula of this compound is

(a) A_2BO_4 (b) AB_2O_4

(c) A_2B_4O (d) A_4B_2O

7. Which of the following statements is false?

(a) Strontium decomposes water readily than beryllium.

(b) Barium carbonate melts at a higher temperature than calcium carbonate.

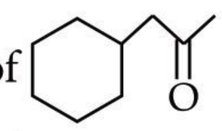
(c) Barium hydroxide is more soluble in water than magnesium hydroxide.

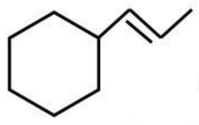
(d) Beryllium hydroxide is more basic than barium hydroxide.

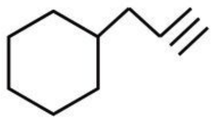
8. Which does not cause coagulation of colloidal solution?

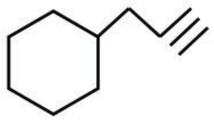
(a) prolonged dialysis (b) non electrolyte

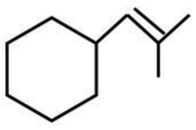
(c) electrolyte (d) all of these.

9. Choose the correct alkyne and reagents for the preparation of 

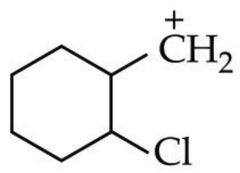
(a)  , $HgSO_4$, H_2SO_4, H_2O

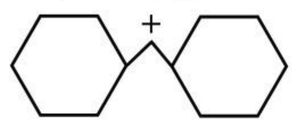
(b)  , $HgSO_4$, H_2SO_4, H_2O

(c)  , BH_3, H_2O_2, NaOH

(d)  , BH_3, H_2O_2, NaOH

10. The decreasing order of stability of the below mentioned carbocations is

(1) $F_3C\overset{+}{C}H_2$ (2) 

(3) $Cl_3C\overset{+}{C}HCH_3$ (4) 

(a) 4 > 3 > 2 > 1 (b) 4 > 2 > 3 > 1

(c) 3 > 4 > 2 > 1 (d) none of these.

11. On increasing the temperature by 10 K the rate of reaction becomes double. Which of the following is the most appropriate reason?

(a) With increase of temperature, velocities increase and hence the number of collisions is appreciably increased.

(b) The activation energy decreases with increase of temperature.

(c) The bonds between the atoms of the reacting molecules become weak at higher temperature.

(d) The higher the temperature, larger is the fraction of colliding particles which can cross the energy barrier.

12. In which of the following compounds B atoms are in sp^2 and sp^3 hybridisation states?

(a) borax (b) diborane

(c) borazole (d) all of these.

13. According to molecular orbital theory which of the following is correct?

(a) C_2 molecule is diamagnetic

(b) C_2^- ion is paramagnetic

(c) bond order of C_2 molecule is 2

(d) all of these.

14. If 0.24 g of a volatile liquid upon vaporisation gives 48 mL of vapours at NTP. What will be the vapour density of the substance?
(Density of $H_2 = 0.089\ g\ L^{-1}$)

(a) 95.39 (b) 5.993 (c) 95.93 (d) 56.0

15. Which of the following is expected to have resultant dipole moment equal to zero?

(a) H_2O_2 (b) O_3 (c) SO_2 (d) XeF_4

16. Pick up the correct statement.

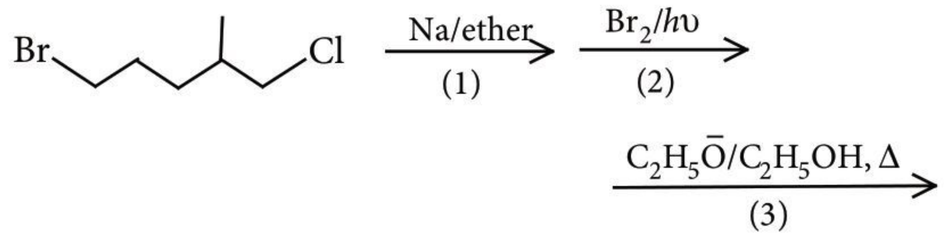
(a) CO which is major pollutant resulting from the combustion of fuels in automobiles plays a major role in photochemical smog.

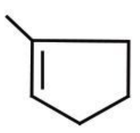
(b) Classical smog has an oxidizing character while the photochemical smog is reducing in character.

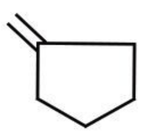
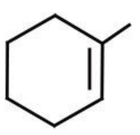
(c) Photochemical smog occurs in day time whereas the classical smog occurs in early morning hours.

(d) During formation of smog the level of ozone in the atmosphere goes down.

17. The major product of the following reaction is



(a)  (b) 

(c)  (d) 

18. One gram atom of graphite and one gram atom of diamond were separately burnt to carbon dioxide. The amount of heat liberated were 393.5 kJ and 395.4 kJ respectively. It shows that

(a) graphite has greater affinity for oxygen

(b) diamond has greater affinity for oxygen

(c) graphite is stable than diamond

(d) diamond is stable than graphite.

19. Which of the following is not a correct statement?

(a) Cassiterite, chromite and pitchblende are concentrated by hydraulic washing (Tabling).

(b) Pure Al_2O_3 is obtained from the bauxite ore by leaching in the Baeyer's process.

(c) Sulphide ore is concentrated by calcination method.

(d) Roasting can convert sulphide into oxide or sulphate and part of sulphide may also act as a reducing agent.

20. **Statement-1 :** Glycine exists as zwitter ion but *o*- and *p*-amino benzoic acid do not.
Statement-2 : Due to the presence of $-NH_2$ and –COOH group within the same molecule, they neutralise each other and hence α-amino acids exist as dipolar ions or zwitter ions.

(a) Statement-1 is true, statement-2 is true; statement-2 is a correct explanation for statement-1.
(b) Statement-1 is true, statement-2 is true; statement-2 is not a correct explanation for statement-1.
(c) Statement-1 is true, statement-2 is false.
(d) Statement-1 is false, statement-2 is true.

21. Match the Column I with Column II and select the correct option.

Column I (Atomic no.)	**Column II (Position in periodic table)**
(A) 52	(1) *s*-block
(B) 56	(2) *p*-block
(C) 57	(3) *d*-block
(D) 60	(4) *f*- block

(a) A – 2, B – 1, C – 3, D – 4
(b) A – 2, B – 1, C – 4, D – 3
(c) A – 1, B – 2, C – 3, D – 4
(d) A – 1, B – 2, C – 4, D – 3

22. Under which of the following conditions would toluene, $C_6H_5—CH_3$ be converted into bromo-methyl benzene $C_6H_5—CH_2Br$?
(a) Reaction with $Br_2/FeBr_3$
(b) Reaction with Br_2 in sunlight
(c) Reaction with Br_2 in dark
(d) Reaction with HBr

23. The IUPAC name for the complex $[Co(NO_2)(NH_3)_5]Cl_2$ is
(a) nitrito-N-pentaamminecobalt(IV) chloride
(b) nitrito-N-pentaamminecobalt(II) chloride
(c) pentaamminenitrito-N-cobalt(II) chloride
(d) pentaamminenitrito-N-cobalt(III) chloride.

24. Chemical *A* is used for water softening to remove temporary hardness. *A* reacts with sodium carbonate to generate caustic soda. When carbon dioxide is bubbled through *A*, it turns milky. What is the chemical formula of *A*?
(a) $CaCO_3$ (b) CaO
(c) $Ca(OH)_2$ (d) $Ca(HCO_3)_2$

25. When 25 g of Na_2SO_4 is dissolved in 10^3 kg of solution, its concentration will be
(a) 2.5 ppm (b) 25 ppm
(c) 250 ppm (d) 100 ppm

26. Identify reactant (*X*) in the given reaction sequence.

$$CH_3COCH_3 + X \longrightarrow (CH_3)_3C—OMg—Cl \xrightarrow{H_2O}$$

$$(CH_3)_3C—OH + Mg\begin{matrix}OH\\Cl\end{matrix}$$

(a) CH_3MgCl (b) $CH_3COCl + Mg$
(c) $MgCl_2$ (d) CH_3CH_2MgCl

27. Stomach acid, a dilute solution of HCl in water, can be neutralized by reaction with sodium hydrogen carbonate,

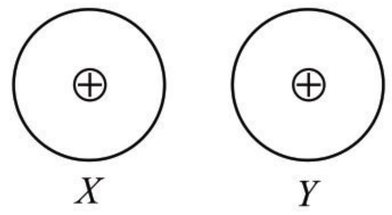
$$NaHCO_{3(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)} + CO_{2\,(g)}$$

How many milliliters of 0.125 M $NaHCO_3$ solution are needed to neutralize 18.0 mL of 0.100 M HCl ?
(a) 14.4 mL (b) 12.0 mL
(c) 14.0 mL (d) 13.2 mL

28. The oxoacid of *P* having oxidation state +4 is
(a) orthophosphoric acid
(b) hypophosphoric acid
(c) phosphoric acid
(d) metaphosphoric acid.

29. *m*-Chlorobenzaldehyde on reaction with conc. KOH in room temperature gives
(a) potassium *m*-chlorobenzoate and *m*-hydro-oxybenzaldehyde
(b) *m*-Hydroxy benzaldehyde and *m*-chlorobenzyl alcohol
(c) *m*-Chlorobenzyl alcohol and *m*-hydroxybenzyl alcohol
(d) potassium *m*-chlorobenzoate and *m*-chloro-benzyl alcohol.

30. Two atoms *X* and *Y* are non-polar and electrically symmetrical.
What type of intermolecular forces of attraction can be developed between them?



(a) Dipole-induced dipole forces
(b) London forces or dispersion forces
(c) Dipole-dipole forces
(d) No forces of any kind.

31. The reduction of iron in a blast furnace involves all the steps except
(a) Fusion (b) Reduction
(c) Sublimation (d) Roasting

32. Which of the following expressions is not applicable to the hydrolysis equilibrium?

$$CN^- + H_2O \rightleftharpoons HCN + OH^-$$

(a) $K_h = \frac{K_w}{K_a}$ (b) $h = \sqrt{\frac{K_h}{C}}$
(c) $pH = \frac{1}{2}pK_a[HCN]$ (d) $[H^+] = \sqrt{\frac{K_w \times K_a}{C}}$

33. For Zn^{2+}, Ni^{2+}, Cu^{2+} and Cr^{2+} which of the following statements is correct?

(a) Only Zn^{2+} is colourless and Ni^{2+}, Cu^{2+} and Cr^{2+} are coloured.

(b) All the ions are coloured.

(c) All the ions are colourless.

(d) Zn^{2+} and Cu^{2+} are colourless while Ni^{2+} and Cr^{2+} are coloured.

34. Match the following :

Column I	Column II
(A) u_{rms}/u_{av}	(i) 1.22
(B) u_{av}/u_{mp}	(ii) 1.13
(C) u_{rms}/u_{mp}	(iii) 1.08

(a) A - (iii), B - (ii), C - (i)

(b) A - (i), B - (ii), C - (iii)

(c) A - (iii), B - (i), C - (ii)

(d) A - (ii), B - (iii), C - (i)

35. Arrange the following compounds in increasing order of oxidation number.

$MnCl_2$, MnO_2, $Mn(OH)_3$, $KMnO_4$

(a) $MnCl_2 < MnO_2 < Mn(OH)_3 < KMnO_4$

(b) $MnO_2 < MnCl_2 < Mn(OH)_3 < KMnO_4$

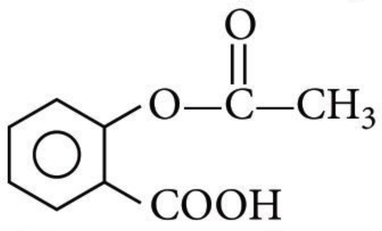
(c) $Mn(OH)_3 < MnCl_2 < MnO_2 < KMnO_4$

(d) $MnCl_2 < Mn(OH)_3 < MnO_2 < KMnO_4$

SECTION - B

Attempt any 10 out of 15.

36. The following compound is used as



(a) an anti-inflammatory compound

(b) analgesic

(c) hypnotic (d) antiseptic.

37. Among CaH_2, NH_3, NaH and B_2H_6, which are covalent hydrides?

(a) NH_3 and B_2H_6 (b) NaH and CaH_2

(c) NaH and NH_3 (d) CaH_2 and B_2H_6

38. $E°$ value of Ni^{2+}/ Ni is –0.25 V and Ag^+ /Ag is +0.80 V. If a cell is made by taking the two electrodes what is the feasibility of the reaction?

(a) Since $E°$ value for the cell will be positive, redox reaction is feasible.

(b) Since $E°$ value for the cell will be negative, redox reaction is not feasible.

(c) Ni cannot reduce Ag^+ to Ag hence reaction is not feasible.

(d) Ag can reduce Ni^{2+} to Ni hence reaction is feasible.

39. The sequence in which amino acids are arranged in a protein is called

(a) primary structure (b) secondary structure

(c) tertiary structure (d) quaternary structure.

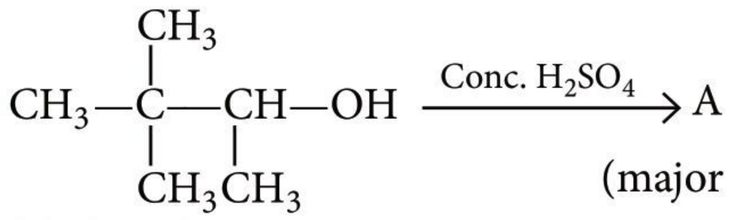
40. Which of the following statements is incorrect?

(a) $B(OH)_3$ partially reacts with water to form H_3O^+ and $[B(OH)_4]^-$, and behaves like a weak acid.

(b) $B(OH)_3$ behaves like a strong monobasic acid in the presence of sugars, and this acid can be titrated against an NaOH solution using phenolphthalein as an indicator.

(c) $B(OH)_3$ does not donate a proton and hence does not form any salt with NaOH.

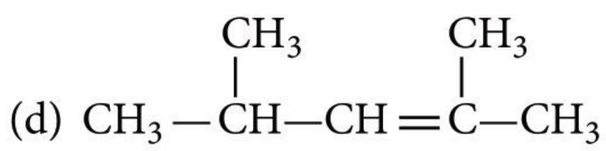
(d) $B(OH)_3$ reacts with NaOH, forming $Na[B(OH)_4]$.

41.  (major product) is

(a) $(CH_3)_3CCH=CH_2$

(b) $(CH_3)_2C=C(CH_3)_2$

(c) 

(d) 

42. Main pollutants released from iron and steel industry are

(a) CO, CO_2 and SO_2 (b) NO, SO_2 and H_2S

(c) CO_2, H_2S and NO_2 (d) CFCs, NO_2 and SO_2.

43. For a nitration of aniline, which of the following steps is followed?

(a) Direct nitration using nitrating mixture (conc. HNO_3 + conc. H_2SO_4) followed by oxidation.

(b) Using fuming HNO_3 carrying out reaction at 273 K followed by hydrolysis.

(c) Using $NaNO_2$ and HCl followed by reaction with conc. HNO_3 followed by hydrolysis.

(d) Acetylation followed by nitration and hydrolysis.

44. Arrange the following in increasing value of magnetic moments.

(i) $[Fe(CN)_6]^{4-}$ (ii) $[Fe(CN)_6]^{3-}$

(iii) $[Cr(NH_3)_6]^{3+}$ (iv) $[Ni(H_2O)_4]^{2+}$

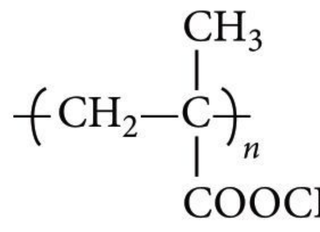
(a) (i) < (ii) < (iii) < (iv)

(b) (i) < (ii) < (iv) < (iii)

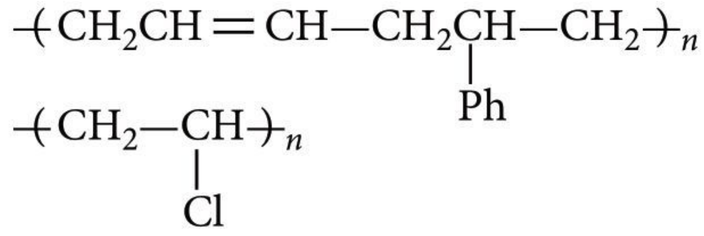
(c) (ii) < (iii) < (i) < (iv)

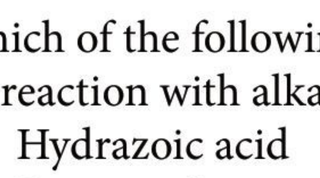
(d) (iii) < (i) < (ii) < (iv)

45. Which of the following is a copolymer?

(a) 

(b) $+CH_2-CH-(C_6H_5+_n$

(c) 

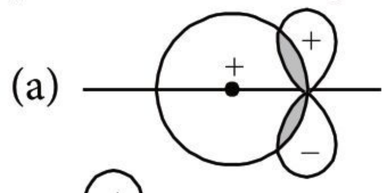
(d) 

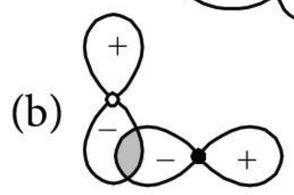
46. Which of the following acids will not evolve H_2 gas on reaction with alkali metals?

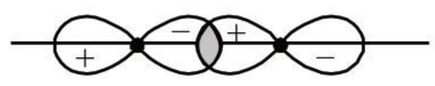
(a) Hydrazoic acid (b) Perxenic acid

(c) Boric acid (d) None of these

47. Which of the following orbital overlappings is not possible according to VBT?

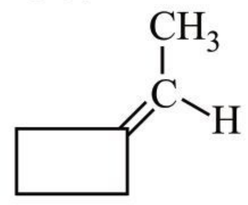
(a) 

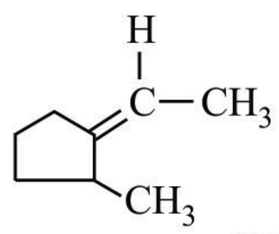
(b) 

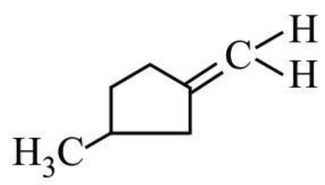
(c) 

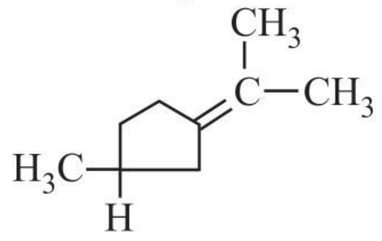
(d) All of these

48. Which of the following can show geometrical isomers?

(a) 

(b) 

(c) 

(d) 

49. Which is correct regarding the cyclic trimer of SO_3?

(a) It contains three S – S, σ bonds

(b) It contains three O – O, σ bonds

(c) It contains six O – O, π bonds

(d) The total number of σ and π bonds in it are 12 and 6 respectively.

50. In free radical polymerisation, the extent of conversion increases with

(a) increase in temperature

(b) increase in polymerisation time

(c) increase in monomer concentration

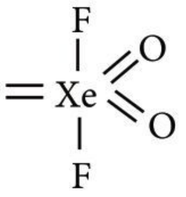
(d) all of the above.

SOLUTIONS

1. **(b)**

2. **(c) :** For first order, $(a - x) = ae^{-kt}$; partial pressure or conc. of the reactant decreases exponentially with time.

3. **(d):** Orbital is not a trajectory so (a) and (b) options are incorrect. All the electrons of an atom cannot be found in one orbital hence (c) is also incorrect. Orbital is characterised by quantum numbers n, l and m.

4. **(d):** The structure of XeO_3F_2 - 

No. of lone pair of Xe = 0 and no. of bond pair = 5

Hybridisation of Xe = sp^3d

Hence, shape of XeO_3F_2 should be trigonal bipyramidal and not octahedral.

5. **(a) :** $PCl_5 \rightleftharpoons PCl_3 + Cl_2$

at t_0 1 0 0

at t_{eq} $1 - x$ x x

$\therefore$ p_{PCl_3} = Total pressure × Mole fraction of PCl_3

$$p_{PCl_3} = P \cdot \left(\frac{x}{1+x}\right)$$

6. **(b):** No. of O^{2-} ions in *ccp* arrangement = 4

No. of octahedral holes = 4

No. of B^{3+} ions = $4 \times \frac{1}{2} = 2$

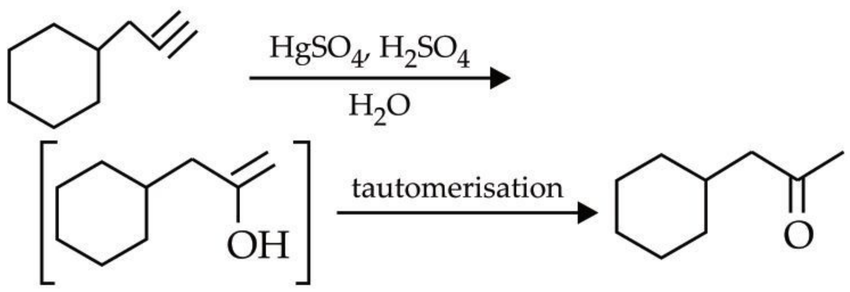
No. of tetrahedral holes = $4 \times 2 = 8$

No. of A^{2+} ions = $8 \times \frac{1}{8} = 1$

Formula AB_2O_4

7. **(d):** Basic strength of alkali metal hydroxides increases down the group. Hence $Ba(OH)_2$ is more basic than $Be(OH)_2$.

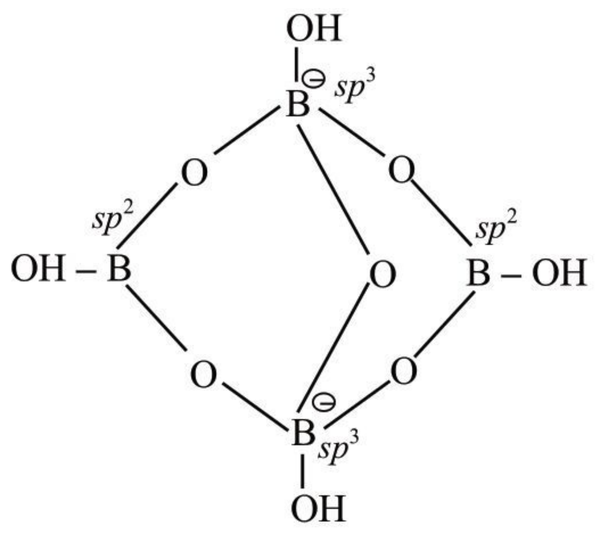
8. **(b):** Non-electrolytes cannot cause coagulation.

9. **(b):** 

10. **(b):** Electron releasing groups stabilize carbocations whereas electron withdrawing groups ($-CF_3$) destabilize.

11. **(d):** In every chemical reaction, there is an energy barrier that every colliding particle has to pass to get converted into product molecules. At higher temperature, larger fraction of colliding (reactant) particles cross the energy barrier and thus rate of reaction is increased.

12. (a) : The correct formula of borax is $Na_2[B_4O_5(OH)_4]\cdot 8H_2O$. The structure of anion is



13. (d): For C_2 the electronic configuration is

$\sigma 1s^2\ \sigma^* 1s^2\ \sigma 2s^2\ \sigma^* 2s^2\ \pi 2p_x^2\ \pi 2p_y^2\ \sigma 2p_z^0$

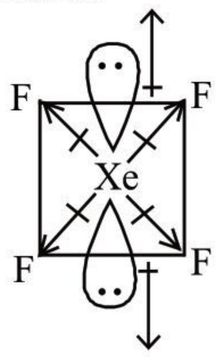
$$\text{Bond order} = \frac{1}{2}(8-4) = 2.$$

14. (d): $$\text{Molecular mass} = \frac{0.24 \times 22400}{48} = 112$$

(By Victor Meyer method)

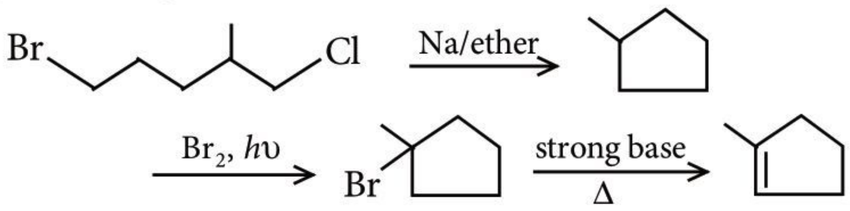
$$\text{Vapour density} = \frac{\text{Molecular mass}}{2} = \frac{112}{2} = 56$$

15. (d): The individual bond moments cancel each other (in symmetrical structure), thus the net dipole moment is zero.



16. (c) : Photochemical smog occurs in summers during day time whereas classical smog is formed in the early morning hours of winter months.

17. (b):



18. (c) : Less the heat of combustion, more stable is the substance.

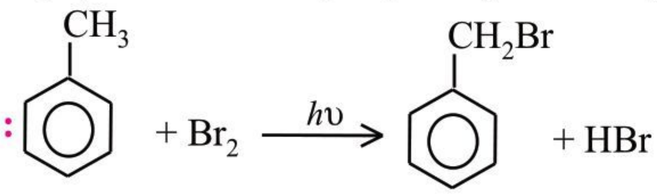
19. (c) : Sulphide ore is concentrated by froth floatation method.

20. (b): In *o*- or *p*-amino benzoic acids, the lone pair of electrons on the $-NH_2$ group is donated towards the benzene ring. As such, the basic character of $-NH_2$ group and acidic character of –COOH group decreases. Therefore, the weakly acidic –COOH group cannot transfer a H^+ ion to the weakly basic $-NH_2$ group therefore, *o*- and *p*-aminobenzoic acids do not exist as zwitter ion.

21. (a) :

	Atomic number	E.C.	Block
(A)	52	[Kr] $5s^2\ 4d^{10}\ 5p^4$	*p*-block (2)
(B)	56	[Xe] $6s^2$	*s*-block (1)
(C)	57	[Xe] $6s^2\ 5d^1$	*d*-block (3)
(D)	60	[Xe] $6s^2\ 4f^4$	*f*-block (4)

22. (b) :



In presence of sunlight substitution takes place in side chain.

23. (d)

24. (c) : $Ca(OH)_2$ is used for softening of temporary hard water. With Na_2CO_3 it gives NaOH.

$$\underset{(A)}{Ca(OH)_2} + Na_2CO_3 \rightarrow 2NaOH + CaCO_3\downarrow$$

Milkiness is produced when CO_2 is passed through a solution of $Ca(OH)_2$ in water. It is due to the formation of $CaCO_{3\,(s)}$.

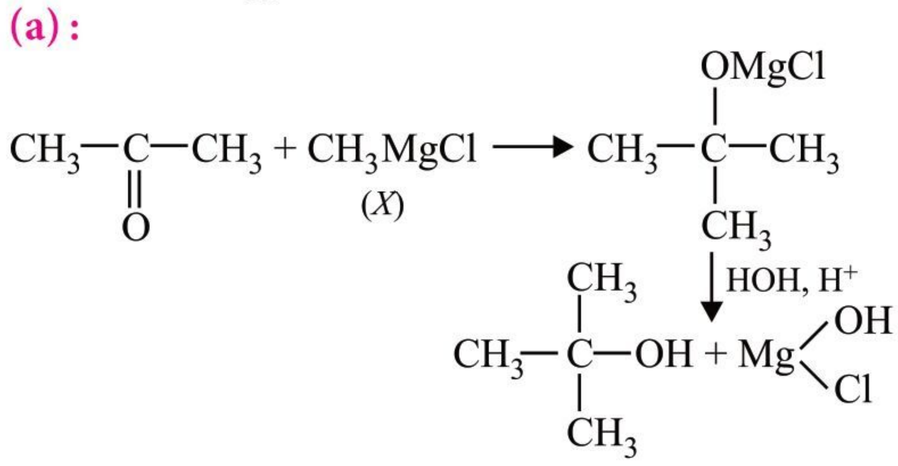
$$Ca(OH)_{2\,(aq)} + CO_{2\,(g)} \rightarrow CaCO_{3\,(s)} + H_2O_{\,(l)}$$

25. (b): When a solute is present in minute amounts (trace quantities), the concentration is expressed in ppm.

$$\text{ppm of } A = \frac{\text{mass of component } A}{\text{total mass of solution}} \times 10^6$$

$$= \frac{0.025}{10^3} \times 10^6 = 25 \text{ ppm}$$

26. (a) :



27. (a) : Given, $M_{HCl} = 0.1$ M, $V_{HCl} = 18.0$ mL

$M_{NaHCO_3} = 0.125$ M, $V_{NaHCO_3} = ?$

On applying, $M_{HCl} \times V_{HCl} = M_{NaHCO_3} \times V_{NaHCO_3}$

$\Rightarrow \quad 0.1 \times 18 = 0.125 \times V_{NaHCO_3}$

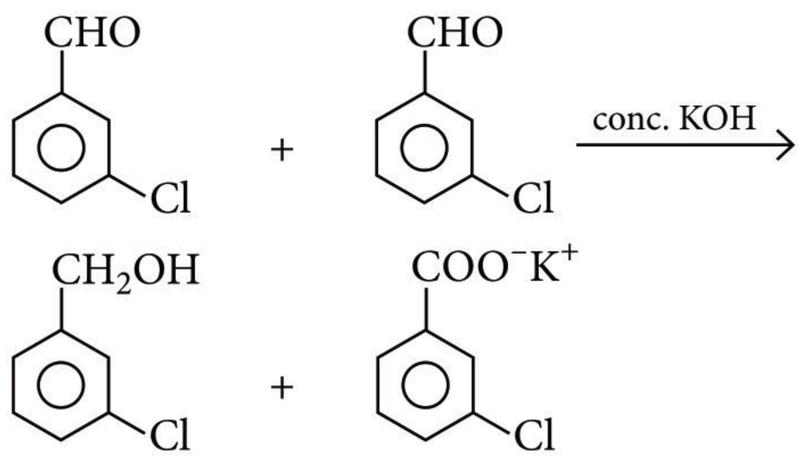
$\Rightarrow \quad M_{NaHCO_3} = 14.4$ mL

Thus, 14.4 mL of the 1.25 M $NaHCO_3$ solution is needed to neutralise 18.0 mL of the 0.100 M HCl solution.

28. (b): Hypophosphoric acid is $H_4P_2O_6$

oxidation state of $P = +4$.

29. (d):



m–Chlorobenzyl alcohol — Potassium *m*-chlorobenzoate

30. (b): In non-polar atom, a dipole may develop momentarily. If the atom *X* becomes unsymmetrical resulting in development of instantaneous dipole for a very short time, it distorts the electron density of *Y* which is close to it and dipole is induced in the atom *Y*. Temporary dipoles *X* and *Y* attract each other. This attraction is called London or dispersion force.

31. (c) **32. (c)**

33. (a): $Zn^{2+}(3d^{10})$ has zero unpaired electron (colourless).
$Ni^{2+}(3d^8)$ has 2 unpaired electrons (coloured).
$Cu^{2+}(3d^9)$ has 1 unpaired electron (coloured).
$Cr^{2+}(3d^4)$ has 4 unpaired electrons (coloured).

34. (a)

35. (d): Oxidation number of Mn

in $\overset{x}{Mn}\overset{-1}{Cl_2}$: $x + 2(-1) = 0 \Rightarrow \quad x = +2$

in $\overset{x}{Mn}\overset{-2}{O_2}$: $x + 2(-2) = 0 \Rightarrow x = +4$

in $\overset{x}{Mn}\overset{-1}{(OH)_3}$: $x + 3(-1) = 0 \Rightarrow x = +3$

in $\overset{+1}{K}\overset{x}{Mn}\overset{-2}{O_4}$: $1(+1) + x + 4(-2) = 0 \Rightarrow x = +7$

Thus increasing order of oxidation number of Mn is
$MnCl_2 < Mn(OH)_3 < MnO_2 < KMnO_4$

36. (b)

37. (a): Non-metal hydrides are covalent hydrides.

38. (a): The cell reaction will be

$Ni_{(s)} + 2Ag^+_{(aq)} \rightarrow Ni^{2+}_{(aq)} + 2Ag_{(s)}$

$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$

$= 0.80 - (-0.25) = +1.05\ V$

$\Delta G^\circ = -nFE^\circ_{cell}$

As E°_{cell} = +ve,

ΔG° = –ve, hence reaction is feasible.

39. (a)

40. (c): Boric acid being acidic in nature forms salt with NaOH known as metaborates.

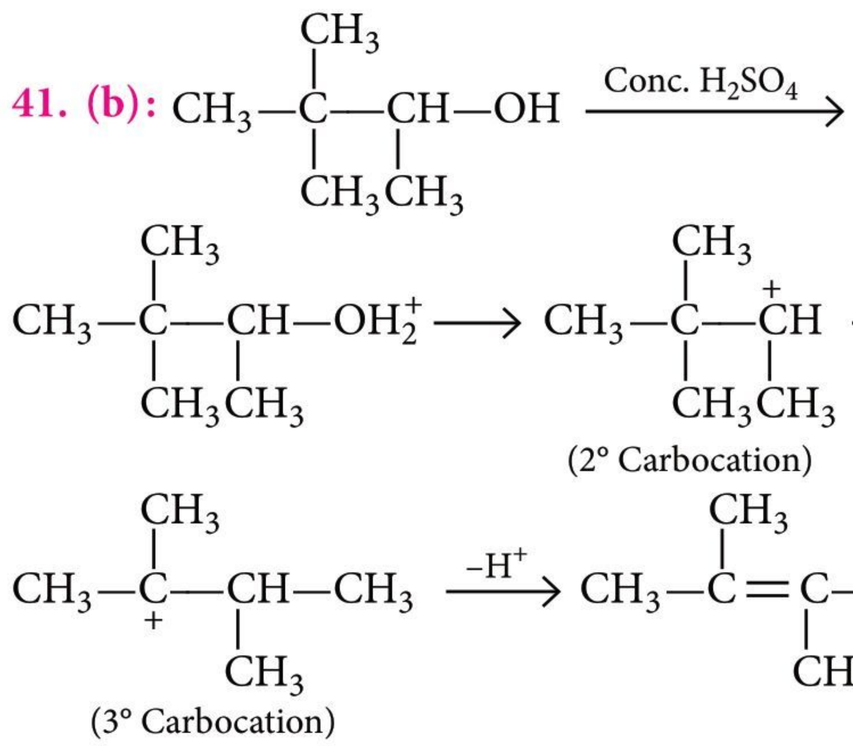
$$B(OH)_3 + NaOH \rightarrow B(OH)_4^- + Na^+$$

$$\downarrow$$

$$Na^+BO_2^- + 2H_2O$$

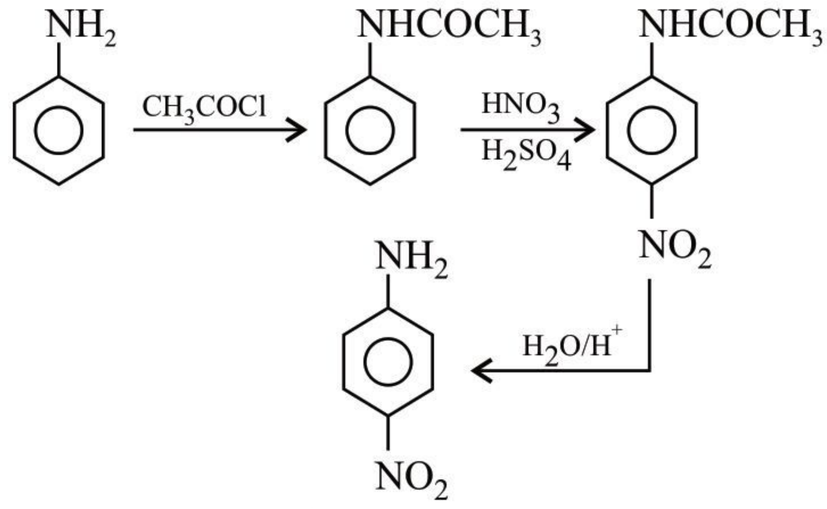
Sodium metaborate

41. (b):



42. (d)

43. (d): $-NH_2$ group is oxidised on direct nitration hence $-NH_2$ group is blocked by acetylation and then nitration is carried out.



44. (b) : $[Fe(CN)_6]^{4-}$; No. of unpaired electrons = 0
$[Fe(CN)_6]^{3-}$; No. of unpaired electrons = 1
$[Ni(H_2O)_4]^{2+}$; No. of unpaired electrons = 2
$[Cr(NH_3)_6]^{3+}$; No. of unpaired electrons = 3

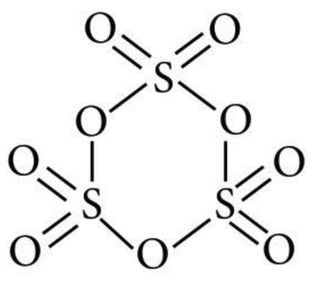
45. (c)

46. (d): None of the acids evolve H_2 gas with alkali metals.

47. (d): Net overlapping will be zero in (a).
(b) is ruled out as it is neither σ nor π-bond.
(c) is not allowed due to opposite signs of ψ functions.

48. (b)

49. (d):



50. (d)

JEE 2022 PRACTICE PAPER ADVANCED

Exam on 3rd July

PAPER - I

SECTION 1

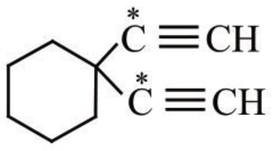
- ***This section contains FOUR (04) questions.***
- ***Each question has FOUR options (a), (b), (c) and (d). ONLY ONE of these four options is the correct answer.***
- ***For each question, choose the correct option corresponding to the correct answer.***
- ***Answer to each question will be evaluated according to the following marking scheme:***

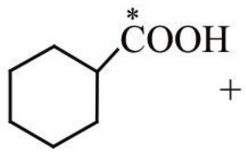
Full Marks : +3 ***If ONLY the correct option is chosen.***

Zero Marks : 0 ***If none of the options is chosen (i.e., the question is unanswered).***

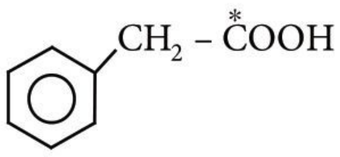
Negative Marks : –1 ***In all other cases.***

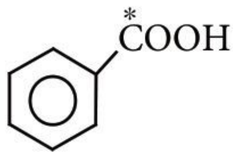
1. The product III of the following reaction sequence is

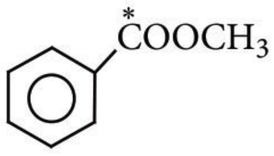
(A)  $\xrightarrow{O_3}$ (I) + 2HCOOH

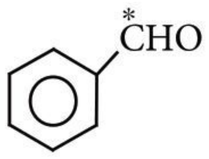
(I) $\xrightarrow{\Delta}$  + (II)

(B) (II) $\xrightarrow{PhMgBr}$ $\xrightarrow{H_3O^+}$ (III)

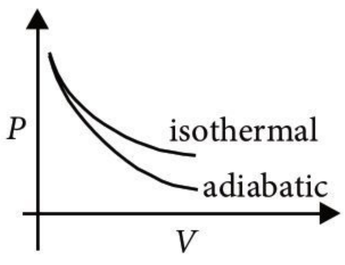
(a) 

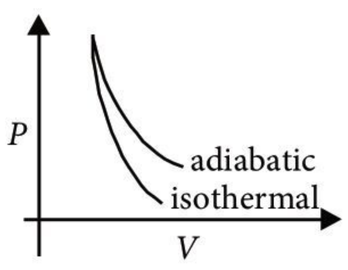
(b) 

(c) 

(d) 

2. The correct figure representing isothermal and adiabatic expansions of an ideal gas from a particular initial state is

(a) 

(b) 

(c)

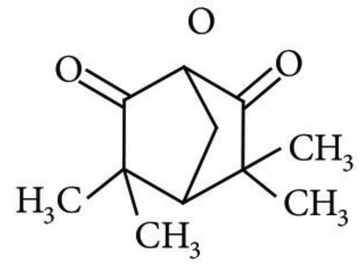
(d)

3. An organic compound *P* on keeping in slightly acidic aqueous solution gives yellow precipitate with 2,4-dinitrophenyl hydrazine. It also decolourises Br_2/CCl_4 solution and gives coloured solution/precipitate with neutral $FeCl_3$ solution. The structure of *P* can be

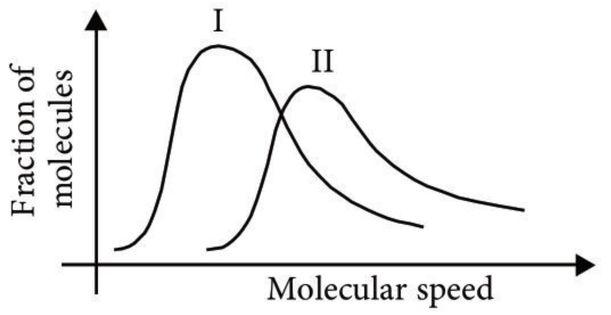
(a) $OHC - C(CH_3)_2 - CHO$

(b) $(CH_3)_3C - \underset{\underset{O}{\|}}{C} - H$

(c) $(CH_3)_3C - \underset{\underset{O}{\|}}{C} - \underset{\underset{CH_3}{|}}{CH} - CHO$

(d) 

4. The graphs representing distribution of molecular speeds at 300 K for gases Cl_2 and N_2 are as shown in figure. Select the correct option. (atomic mass of N = 14 and Cl = 35.5)



(a) I graph is for N_2 and II is for Cl_2.

(b) II graph is for N_2 and I is for Cl_2.

(c) Either graph can be taken for N_2 or Cl_2.

(d) Information is not sufficient.

SECTION 2

- ***This section contains THREE (03) question stems.***
- ***There are TWO (02) questions corresponding to each question stem.***
- ***The answer to each question is a NUMERICAL VALUE.***
- ***For each question, enter the correct numerical value corresponding to the answer in the designated place using the mouse and the on-screen virtual numeric keypad.***
- ***If the numerical value has more than two decimal places, truncate/round-off the value to TWO decimal places.***
- ***Answer to each question will be evaluated according to the following marking scheme:***

Full Marks :	***+2***	***If ONLY the correct numerical value is entered at the designated place***
Zero Marks :	***0***	***In all other cases.***

Question Stem for Question Nos. 5 and 6

Question Stem

The properties which depend only on the number of solute particles and not on the nature of the solute are known as colligative properties. The four colligative properties are (i) relative lowering of vapour pressure, (ii) elevation in boiling point, (iii) depression in freezing point and (iv) osmotic pressure. If a non-volatile solute is added to the solvent, vapour pressure of the solution decreases and thus, boiling point increases and freezing point decreases.

The addition of 3 g of a substance to 100 g CCl_4 (M = 154 g mol^{-1}) raises the boiling point of CCl_4 by 0.60°C. K_b of CCl_4 is 5.03 K kg mol^{-1} , K_f of CCl_4 is 31.8 K kg mol^{-1} and density of solution is 1.64 g cm^{-3}.

5. The molar mass of the substance is _____.

6. The relative lowering of vapour pressure of the solution is _____.

Question Stem for Question Nos. 7 and 8

Question Stem

Following data are given for the reaction between A and B.

[A]/mol L^{-1}	[B]/mol L^{-1}	Initial rate/mol L^{-1} s^{-1} at	
		300 K	320 K
2.5×10^{-4}	3.0×10^{-5}	5.0×10^{-4}	2.0×10^{-3}
5.0×10^{-4}	6.0×10^{-5}	4.0×10^{-3}	–
1.0×10^{-3}	6.0×10^{-5}	1.6×10^{-2}	–

If the order with respect to A is x and with respect to B is y and value of rate constant is $z \times 10^8$ M^{-2} s^{-1}.

7. The value of y is _____.

8. The value of z is _____.

Question Stem for Question Nos. 9 and 10

Question Stem

A mixture of two aromatic compounds (A) and (B) was separated by dissolving in chloroform followed by extraction with aqueous KOH solution. The organic layer containing (A), when heated with alcoholic solution of KOH produces C_7H_5N (C) associated with unpleasant odour. Number of —CHO group in B is x and number of $—NH_2$ group in A is y.

9. The value of x is _____.

10. The value of y is _____.

SECTION 3

- ***This section contains SIX (06) questions.***
- ***Each question has FOUR options (a), (b), (c) and (d). ONE OR MORE THAN ONE of these four option(s) is (are) correct answer(s).***
- ***For each question, choose the option(s) corresponding to (all) the correct answer(s).***
- ***Answer to each question will be evaluated according to the following marking scheme:***

Full Marks :	***+4***	***If only (all) the correct option(s) is(are) chosen;***
Partial Marks :	***+3***	***If all the four options are correct but ONLY three options are chosen;***
Partial Marks :	***+2***	***If three or more options are correct but ONLY two options are chosen, both of which are correct;***
Partial Marks :	***+1***	***If two or more options are correct but ONLY one option is chosen and it is a correct option;***
Zero Marks :	***0***	***If unanswered;***
Negative Marks :	***–2***	***In all other cases.***

For example, in a question, if (a), (b) and (d) are the ONLY three options corresponding to correct answers, then
choosing ONLY (a), (b) and (d) will get +4 marks;
choosing ONLY (a) and (b) will get +2 marks;
choosing ONLY (a) and (d) will get +2 marks;
choosing ONLY (b) and (d) will get +2 marks;
choosing ONLY (a) will get +1 mark;
choosing ONLY (b) will get +1 mark;
choosing ONLY (d) will get +1 mark;
choosing no option(s) (i.e., the question is unanswered) will get 0 marks and
choosing any other option(s) will get –2 marks.

11. In which of the following reaction/s alcohol will be formed as the final product?

(a) $(CH_3CH_2CH_2)_3B \xrightarrow{H_2O_2 + NaOH}$

18+

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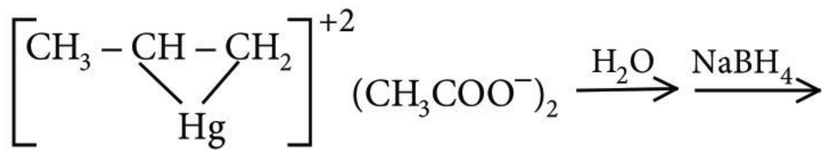
(b) 

(c) $CH_3 - CH{=}CHMgBr \xrightarrow{O_2,\ \Delta} \xrightarrow{H_2O}$

(d) $CH_3 - CH_2 - CH_2MgBr \xrightarrow{\text{O}\!\!\diagup\!\!\diagdown\text{O}\ ,\ THF} \xrightarrow{H_3O^+}$

12. If equal volumes of following solutions are mixed, then in which case is the pH of resulting solution will be average value of pH of two solutions?

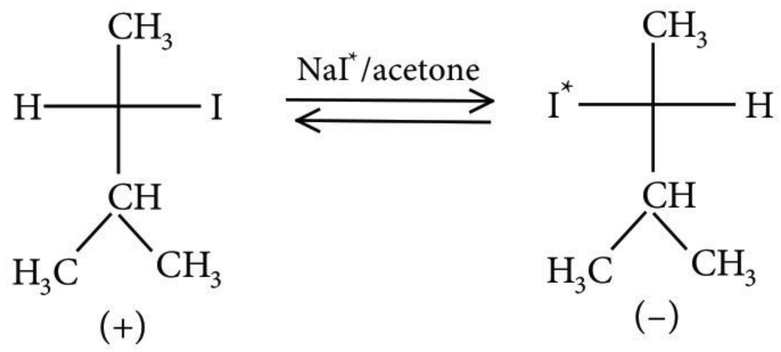
(a) pH = 2 for HCl and pH = 12 for NaOH

(b) pH = 2 for HCl and pH = 4 for HCl

(c) pH = 2 for HCN and pH = 12 for NaOH (K_a of HCN = 10^{-10})

(d) pH = 5 for CH_3COOH and pH = 9 for $NH_{3(aq)}$, K_a (CH_3COOH) = K_b ($NH_{3(aq)}$)

13. Which statements is/are correct about the following reaction?



(a) The reaction passes through formation of a reactive intermediate.

(b) The rate of reaction is the rate of isotopic exchange.

(c) The initial rate of racemization is twice the initial rate of isotopic exchange.

(d) The reactant and product molecules have same (identical) orientation in space because I^{*-} overlaps the same lobe of orbital of carbon to which I^- is overlapped.

14. Which of the following is/are example of banana bond?

(a) Al_2Cl_6 (b) $Al_2(CH_3)_6$

(c) B_2H_6 (d) I_2Cl_6

15. Which of the following has/have linear shape?

(a) HCN (b) $(CN)_2$

(c) C_3O_2 (d) CO_2

16. For which of the following reactions, change of enthalpy is equals to the change in internal energy?

(a) $H_{2(g)} + I_{2(g)} \rightarrow 2HI_{(g)}$

(b) $PCl_{5(g)} \rightarrow PCl_{3(g)} + Cl_{2(g)}$

(c) $2H_2O_{2(aq)} \rightarrow 2H_2O_{(l)} + O_{2(g)}$

(d) $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$

SECTION 4

- ***This section contains THREE (03) questions.***
- ***The answer to each question is a NON-NEGATIVE INTEGER.***
- ***For each question, enter the correct integer corresponding to the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.***
- ***Answer to each question will be evaluated according to the following marking scheme:***

Full Marks : ***+4*** ***If ONLY the correct integer is entered;***

Zero Marks : ***0*** ***In all other cases.***

17. The number of intermediates formed in the conversions of glucose into fructose by osazone method is _____.

18. To 8.4 mL H_2O_2, excess of acidified solution of KI was added. The iodine liberated required 20 mL of 0.3 N $Na_2S_2O_3$ solution. Volume strength of H_2O_2 solution is _____.

19. The total number of stereoisomers shown by $[Cr(NH_3)_4Cl_2]Br$ is _____.

PAPER - II

SECTION 1

- ***This section contains SIX (06) questions.***
- ***Each question has FOUR options (a), (b), (c) and (d). ONE OR MORE THAN ONE of these four option(s) is (are) correct answer(s).***
- ***For each question, choose the option(s) corresponding to (all) the correct answer(s).***
- ***Answer to each question will be evaluated according to the following marking scheme:***

Full Marks : ***+4*** ***If only (all) the correct option(s) is(are) chosen;***

Partial Marks : ***+3*** ***If all the four options are correct but ONLY three options are chosen;***

Partial Marks : ***+2*** ***If three or more options are correct but ONLY two options are chosen, both of which are correct;***

Partial Marks : ***+1*** ***If two or more options are correct but ONLY one option is chosen and it is a correct option;***

Zero Marks : ***0*** ***If unanswered;***

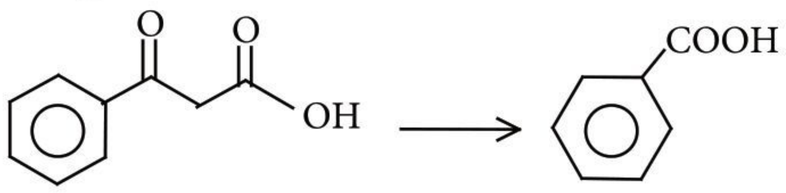
Negative Marks : ***–2*** ***In all other cases.***

For example, in a question, if (a), (b) and (d) are the ONLY three options corresponding to correct answers, then
choosing ONLY (a), (b) and (d) will get +4 marks;
choosing ONLY (a) and (b) will get +2 marks;
choosing ONLY (a) and (d) will get +2 marks;
choosing ONLY (b) and (d) will get +2 marks;
choosing ONLY (a) will get +1 mark;
choosing ONLY (b) will get +1 mark;
choosing ONLY (d) will get +1 mark;
choosing no option(s) (i.e. the question is unanswered) will get 0 marks and
choosing any other option(s) will get –2 marks.

1. The amount 1 mole of lime (CaO) produced by heating 100 g of 90% pure limestone is/are
(a) 50.4 g (b) 0.98 mol
(c) 0.90 mol (d) 56.0 g

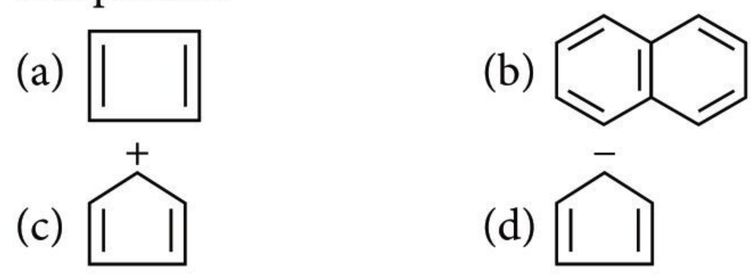
2. Stacking of square close packed layers give rise to
(a) *bcc* structure
(b) *fcc* structure
(c) simple cubic structure
(d) *hcp* structure.

3. Select the correct reactions sequences by which the following reaction can be carried out.



(a) $\xrightarrow{Zn/Hg/HCl,\Delta} \xrightarrow{Br_2/h\upsilon} \xrightarrow{KCN} \xrightarrow{H_3O^+,\Delta}$
(b) $\xrightarrow{NaBH_4} \xrightarrow{Al_2O_3/\Delta} \xrightarrow{O_3/H_2O\ (oxidative)}$
(c) $\xrightarrow{heat} \xrightarrow{I_2/NaOH,\Delta} \xrightarrow{H^+}$
(d) $KMnO_4/OH^-/$ heat

4. Which of the following is/are anti-aromatic compound?



5. Which of the following statements is/are correct?
(a) The electronic configuration of Cr is [Ar] $3d^5\ 4s^1$.
(b) The magnetic quantum number may have a negative value.
(c) In silver atom, 23 electrons have spin of one type and 24 of the opposite type.
(d) The oxidation state of nitrogen in NH_3 is –3.

6. Which of the following behaves both as a nucleophile and as an electrophile?
(a) $H_3C—C\equiv N$ (b) CH_3OH
(c) $H_2C=CH—CH_3$ (d) $H_3C—NH_2$

SECTION 2

- ***This section contains THREE (03) question stems.***
- ***There are TWO (02) questions corresponding to each question stem.***
- ***The answer to each question is a NUMERICAL VALUE.***
- ***For each question, enter the correct numerical value corresponding to the answer in the designated place using the mouse and the on-screen virtual numeric keypad.***
- ***If the numerical value has more than two decimal places, truncate/round-off the value to TWO decimal places.***
- ***Answer to each question will be evaluated according to the following marking scheme:***

Full Marks : ***+2*** ***If ONLY the correct numerical value is entered at the designated place;***

Zero Marks : ***0*** ***In all other cases.***

Question Stem for Question Nos. 7 and 8

Question Stem

Xenon, because of its lowest ionisation energy in its group, can form compounds with oxygen and fluorine. The compounds XeF_2, XeF_4 and XeF_6 are all white solids. They can be sublimed at room temperature, and can be stored indefinitely in nickel containers. The lower fluorides form higher fluorides when heated with F_2 under pressure. The fluorides are all extremely strong oxidising and fluorinating agents.

The fluorides differ in their reactivity with water. XeF_2 is soluble in water, but undergoes slow hydrolysis. XeF_4 and XeF_6 react violently with water. The number of lone pairs on XeF_2, XeF_4 and XeF_6 is x, y and z respectively. When XeF_6 undergoes hydrolysis it produces a compound A which is trigonal pyramidal and has n number of oxygen atoms.

7. The value of $x + y + z$ is _____.

8. The value of n^2 is _____.

Question Stem for Question Nos. 9 and 10

Question Stem

An intimate mixture of Fe_2O_3 and Al is used in solid fuel rocket.

$\Delta H_{Al_2O_3} = 399.0$ kcal, $\Delta H_{Fe_2O_3} = 199.0$ kcal

Density of Fe_2O_3 and Al are 5.2 g mL^{-1} and 2.7 g mL^{-1} respectively.

9. Total volume of the fuel mixture is _____ mL

10. The fuel value per mL of the mixture is _____ kcal mL^{-1}

Question Stem for Question Nos. 11 and 12

Question Stem

The relation between $E°$ and equilibrium constant is given by the formula : $E° = \frac{0.0591}{n} \times \log K_C$.

For a cell $Zn \mid Zn^{2+}_{(aq)} \parallel Cu^{2+} \mid Cu$, $E°$ is 1.10 V.

The equilibrium constant for the cell reaction

$Zn + Cu^{2+}_{(aq)} \rightleftharpoons Cu + Zn^{2+}_{(aq)}$

is found to be $x \times 10^y$

11. The value of x is _____.

12. The value of $y - 17$ is _____.

SECTION 3

- ***This section contains TWO (02) paragraphs. Based on each paragraph, there are TWO (02) questions.***
- ***Each question has FOUR options (a), (b), (c) and (d). ONLY ONE of these four options is the correct answer.***
- ***For each question, choose the option corresponding to the correct answer.***
- ***Answer to each question will be evaluated according to the following marking scheme:***

Full Marks :	***+3***	***If ONLY the correct option is chosen;***
Zero Marks :	***0***	***If none of the options is chosen (i.e., the question is unanswered);***
Negative Marks :	***–1***	***In all other cases.***

Paragraph-1

Polymers are high molecular mass macro sized molecules consisting of repeating units of monomers. All polymers are macromolecules but all macro-molecules are not polymers. Polymers can also be classified on the basis of mode of their synthesis as

Addition polymers : The polymers formed by direct addition of a large number of monomers are called addition polymers. For example, polyethene,

$$n CH_2 — CH_2 \longrightarrow \text{-}(CH_2 — CH_2)\text{-}_n$$

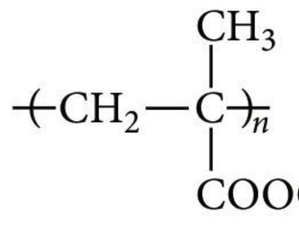
Condensation polymers : The polymers formed by the condensation of two or more than two monomers by the loss of H_2O, HCl, etc. are called condensation polymers.

13. Match the column I with column II and select the correct option.

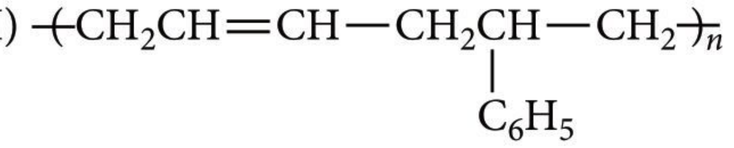
	Column I		**Column II**
(A)	Natural rubber	(p)	polyamide
(B)	PVC	(q)	copolymer
(C)	Nylon-6	(r)	homopolymer
(D)	Bakelite		

(a) A → p ; B → p ; C → q ; D → r
(b) A → r ; B → r ; C → p ; D → q
(c) A → p, r ; B → q ; C → p ; D → r
(d) A → p ; B → r ; C → p, r ; D → r

14. Which of the following is a copolymer?

(I) 

(II) $\text{-}(CH_2 — CH — (C_6H_5))\text{-}_n$

(III) 

(a) I only (b) II only
(c) III only (d) None of these

Paragraph-2

The amount of energy released when an electron is added to an isolated gaseous atom to produce a gaseous anion is called electron affinity. Usually only one electron is added, forming a uninegative ion. Since, energy is evolved these terms have negative sign. Electron affinities depend on

(i) atomic size
(ii) effective nuclear charge
(iii) screening effect
(iv) half and fully filled orbitals and
(v) shape of the orbital

Electron affinity cannot be determined directly, but are obtained indirectly from the Born-Haber cycle.

Negative electron affinity values indicate that energy is given out when the atom accepts an electron.

Energy is evolved when one electron is added to an O or S atom, forming the species O^- and S^-, but a substantial amount of energy is absorbed when two electrons are added to form O^{2-} and S^{2-} ions. Thus, the electron affinities for $O \rightarrow O^{2-}$ and $S \rightarrow S^{2-}$ have a positive sign.

15. In which of the following process, energy is liberated?

(a) $Cl \rightarrow Cl^+ + e^-$ (b) $HCl \rightarrow H^+ + Cl^-$

(c) $Cl + e^- \rightarrow Cl^-$ (d) $O^- + e^- \rightarrow O^{2-}$

16. The lower electron affinity of fluorine than that of chlorine is due to

(a) smaller size

(b) smaller nuclear charge

(c) difference in their electronic configurations

(d) its highest reactivity.

SECTION 4

- ***This section contains THREE (03) questions.***
- ***The answer to each question is a NON-NEGATIVE INTEGER.***
- ***For each question, enter the correct integer corresponding to the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.***
- ***Answer to each question will be evaluated according to the following marking scheme:***

Full Marks : ***+4*** ***If ONLY the correct integer is entered;***

Zero Marks : ***0*** ***In all other cases.***

17. The number of moles of acidified $KMnO_4$ required to convert one mole of sulphite ion into sulphate ion is $\frac{x}{y}$ then $(x + y)$ is _____.

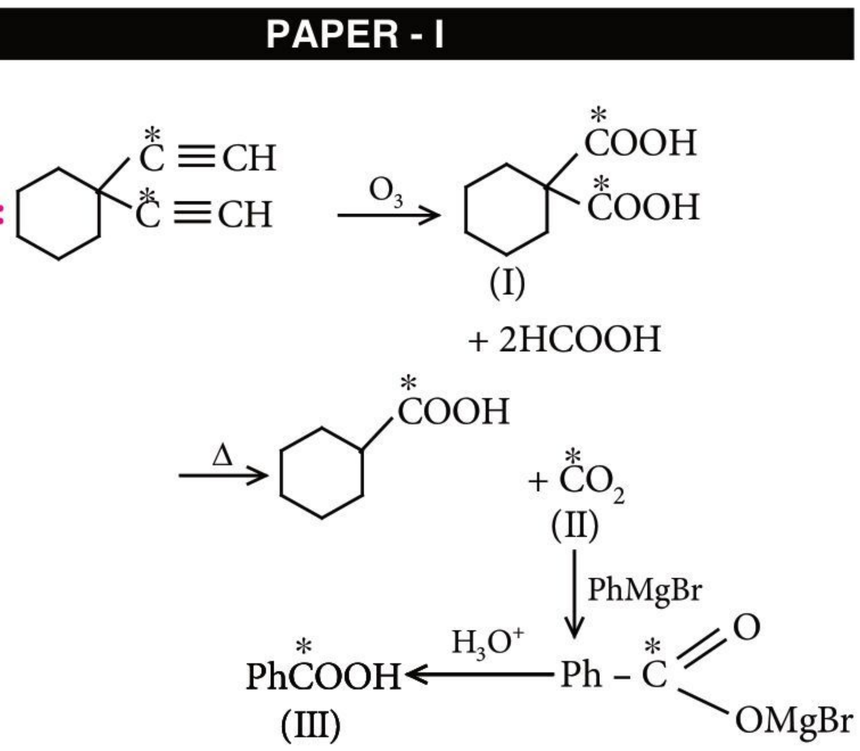
18. When an inorganic compound reacts with SO_2 in aqueous medium then produces (A). (A) on reaction with Na_2CO_3 gives compound (B) which with sulphur gives (C), which is used in photography. The number of π bonds in (C) is ___.

19. The enthalpy of neutralization of NH_4OH and CH_3COOH is –10.5 kcal/mol and enthalpy of neutralization of CH_3COOH with strong base is 12.5 kcal/mol. The enthalpy of ionization of NH_4OH is _____.

SOLUTIONS

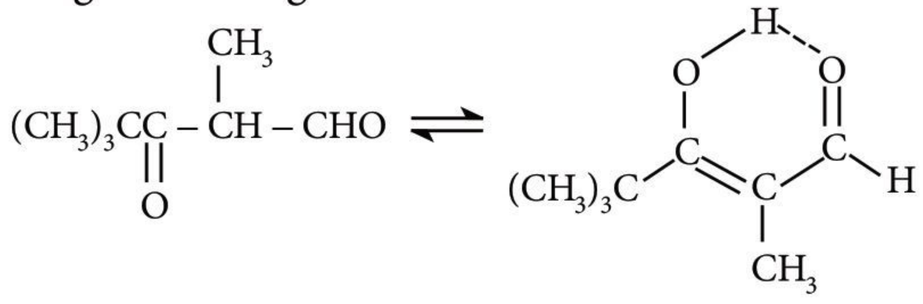
PAPER - I

1. (b) :



2. (a) : Slope of adiabatic curve is greater than isothermal curve.

3. (c) : The enol content of β-keto aldehyde is very high because of conjugation and intramolecular hydrogen bonding.



4. (b) : Molecular weight of Cl_2 is more than molecular weight of N_2. So, molecular speed of Cl_2 will be less as compare to N_2.

5. (250) : As $\Delta T_b = K_b.m$

$$0.60 = 5.03 \times m \Rightarrow m = \frac{0.60}{5.03} = 0.19 \approx 0.12$$

From the molality of the solution we get,

$$\text{molality} = \frac{n_2}{m_1} = \frac{m_2/M_2}{m_1} \quad \text{or,} \quad 0.12 \text{ mol kg}^{-1} = \frac{3 \text{ g}/M_2}{100 \text{ g}}$$

$$\text{or,} \quad M_2 = \left(\frac{3}{100}\right)\left(\frac{1}{0.12 \text{ mol kg}^{-1}}\right)$$

$$= 0.25 \text{ kg mol}^{-1} = 250 \text{ g mol}^{-1}$$

6. (0.018) : $\frac{p^\circ - p_s}{p^\circ} = x_2 = \frac{n_2}{n_1 + n_2}$,

$$\frac{p^\circ - p_s}{p^\circ} = \frac{(3 \text{ g} / M_2)}{(100 \text{ g}/154 \text{ g mol}^{-1}) + (3 \text{ g}/M_2)}$$

$$\frac{p^\circ - p_s}{p^\circ} = \frac{(3/250)}{(100/154) + (3/250)} = 0.01814 \approx 0.018$$

7. (1) : Let x and y be the orders of the reaction with respect to A and B respectively. Rate equation will be

$$r = k[A]^x [B]^y$$

From second and third data,

4.0×10^{-3} M $s^{-1} = k$ $[5.0 \times 10^{-4}$ M$]^x$ $[6.0 \times 10^{-5}$ M$]^y$

1.6×10^{-2} M $s^{-1} = k$ $[1.0 \times 10^{-3}$ M$]^x$ $[6.0 \times 10^{-5}$ M$]^y$

Dividing the two expressions,

$$\frac{1.6 \times 10^{-2}}{4.0 \times 10^{-3}} = \left[\frac{1.0 \times 10^{-3}}{5.0 \times 10^{-4}}\right]^x$$

i.e., $4 = 2^x \Rightarrow$ Hence, $x = 2$.

From the first and second data,

$5.0 \times 10^{-4}\ M\ s^{-1} = k\ [2.5 \times 10^{-4}\ M]^2\ [3.0 \times 10^{-5}\ M]^y$

$4.0 \times 10^{-3}\ M\ s^{-1} = k\ [5.0 \times 10^{-4}\ M]^2\ [6.0 \times 10^{-5}\ M]^y$

Dividing these two expressions,

$$\frac{4.0\times10^{-3}}{5.0\times10^{-4}} = \left(\frac{5.0\times10^{-4}}{2.5\times10^{-4}}\right)^2 \left(\frac{6.0\times10^{-5}}{3.0\times10^{-5}}\right)^y$$

i.e. $8 = 2^2\ 2^y \Rightarrow$ Hence, $y = 1$.

Thus, the order of the reaction with respect to *A* and *B* are 2 and 1 respectively.

8. (2.67) : The rate constant is $k = \dfrac{r}{[A]^2\,[B]}$

From the first data at 300 K, we get

$$k = \frac{5.0\times10^{-4}\ M\ s^{-1}}{(2.5\times10^{-4}\ M)^2 (3.0\times10^{-5}\ M)} = 2.67 \times 10^8\ M^{-2}\ s^{-1}$$

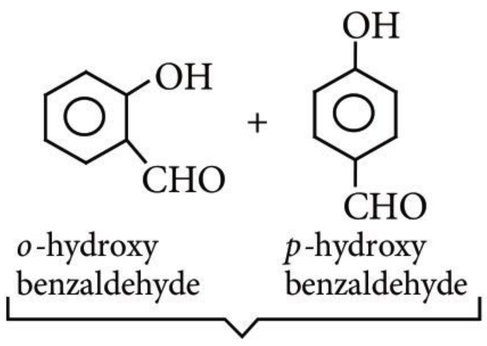
9. (0) : Given, mixture of (*A*) and (*B*) $\xrightarrow[+\ KOH\ (aq.)]{CHCl_3}$

Organic layer (*A*) + Alkaline aqueous layer (*B*)

Alkaline layer on treating with $CHCl_3$ followed by acidification gives two isomers having formula ($C_7H_6O_2$). This is Reimer-Tiemann reaction and thus (*B*) is C_6H_5OH.

$C_6H_5OH + CHCl_3 + KOH_{(aq.)} \xrightarrow{H^+}$

Phenol (*B*)



o-hydroxy benzaldehyde — *p*-hydroxy benzaldehyde

10. (1) : Organic layer on treating with KOH (alc.) produces (C_7H_5N) (*C*) of unpleasant odour and thus, (*C*) is C_6H_5NC. Therefore, (*A*) is $C_6H_5NH_2$. This is carbylamine reaction.

$C_6H_5NH_2 + CHCl_3 + 3KOH\ (alc.) \rightarrow C_6H_5NC + 3KCl + 3H_2O$

(Aniline) (*A*) — Phenyl isocyanide (C)

11. (a, b, d) :

(a) $(CH_3CH_2CH_2)_3B \xrightarrow[H_2O_2]{HO^-} 3CH_3CH_2CH_2OH + H_3BO_3$

(b) $CH_3 - CH(:OH_2) - CH_2 \xrightarrow{-H^\oplus} CH_3 - CH(OH) - CH_2 - HgOAc$

(Mercurinium salt)

$\xrightarrow[\text{Demercuration}]{NaBH_4/HO^-} CH_3 - CH(OH) - CH_3$

(c) $CH_3 - CH{=}CHMgBr \xrightarrow[(ii)\ H_2O]{(i)\ O_2,\ \Delta}$

$CH_3 - CH{=}CH - OH \xrightarrow{\text{tautomerises}} CH_3 - CH_2 - CHO$

(d) $CH_3 - CH_2 - CH_2MgBr + CH_2 - CH_2 \xrightarrow{(THF)}$

$(CH_3CH_2CH_2CH_2CH_2OMgBr) \xrightarrow{H_3O^+} CH_3CH_2CH_2CH_2CH_2OH + Mg(OH)Br$

12. (a, d) : (a) pH = 2 for HCl so, $[HCl] = 10^{-2}$

pH = 12 for NaOH so, $[NaOH] = 10^{-2}$

Hence, pH of mixture = 7 (neutral)

(d) pH = 5 for CH_3COOH and pH = 9 for $NH_{3(aq)}$,

Both must be of equal concentrations as $pK_a = pK_b$.

On mixing equal volume we will get CH_3COONH_4 salt solution and its pH is given by

$$pH = \frac{1}{2}(pK_w + pK_a - pK_b) = 7$$

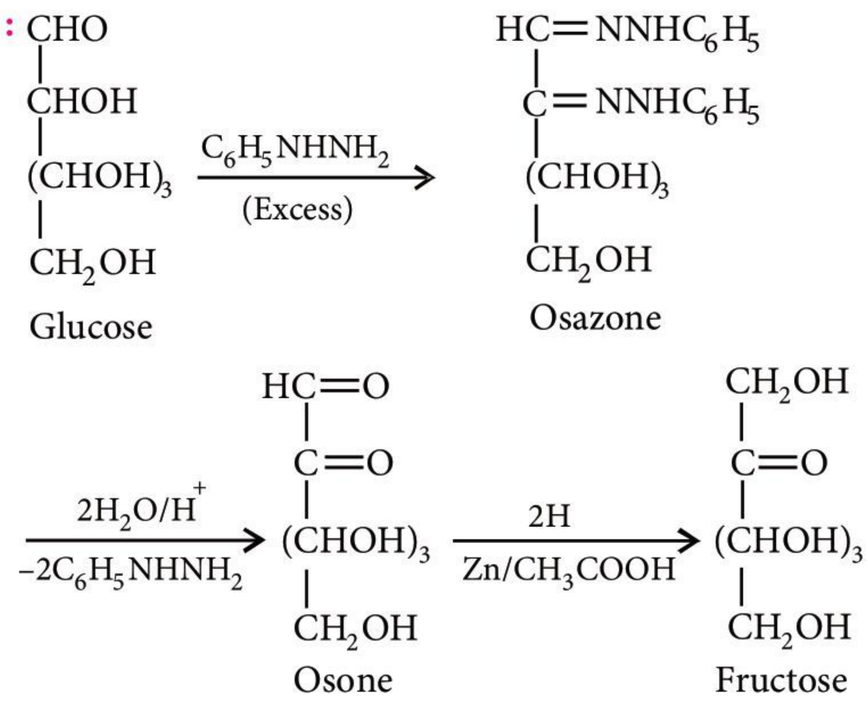
13. (b, c) : It is an S_N2 reaction in which the nucleophile and leaving group are isotopes, there is a Walden inversion in the product. One mole of inversion causes two moles of racemic mixture. Therefore, rate of reaction is the rate of isotope exchange and rate of racemisation is twice of rate of isotopic exchange.

14. (b, c) : $Al_2(CH_3)_6$ and B_2H_6 both have three centre two electron bonds.

15. (a, b, c, d) : $H-C{\equiv}N$; $N{\equiv}C-C{\equiv}N$; $O{=}C{=}C{=}C{=}O$; $O{=}C{=}O$

16. (a, d) : In (a) and (d) choices, the value of $\Delta n_{(g)} = 0$. Therefore $\Delta H = \Delta E$.

17. (2) :



Glucose — Osazone — Osone — Fructose

18. (4) : $H_2O_2 + 2I^- + 2H^+ \rightarrow 2H_2O + I_2$

$I_2 + 2S_2O_3^{2-} \rightarrow S_4O_6^{2-} + 2I^-$

$N_1V_1 = N_2V_2$

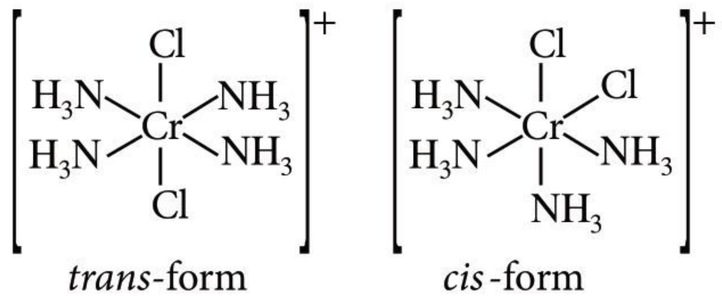
(H_2O_2) $(Na_2S_2O_3)$

$N_1 \times 8.4 = 0.3 \times 20 \implies N_1 = 0.7143\ N$

Normality of H_2O_2 is related to x (volume strength) by relation,

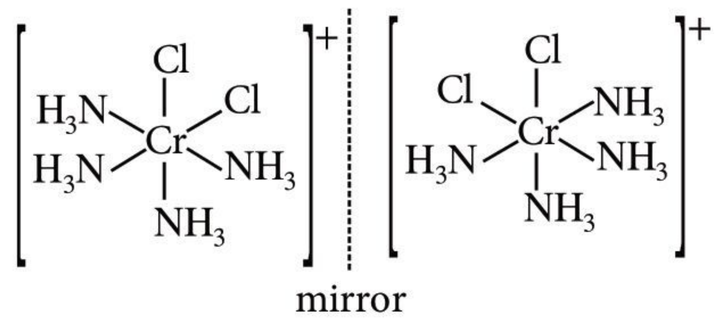
$$N = \frac{x}{5.6} \implies x = N_1 \times 5.6 = 0.7143 \times 5.6 = 4$$

19. (3) : $[Cr(NH_3)_4Cl_2]Br$ is an octahedral compound and exists in two geometrical isomeric forms.



trans-form *cis*-form

The *trans*-isomer has an element of symmetry and hence, does not exhibit optical isomerism, however *cis*-isomer does not have any such element of symmetry and exists in *d*- and *l*-forms.



mirror

Thus, there are total 3 stereoisomers.

PAPER - II

1. (a, c) : $CaCO_3 \underset{\text{Limestone}}{\rightarrow} \underset{\text{Lime}}{CaO} + CO_2 \uparrow$

1 mole of $CaCO_3$ = 100 g

$\because$ $CaCO_3$ being heated is 90% pure,

$\therefore$ $\frac{90}{100} \times 100 = 90$ g

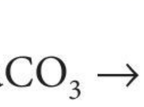
100 g $CaCO_3$ gives 56 g CaO.

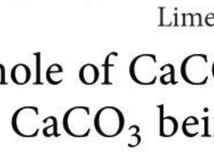
$\therefore$ 90 g $CaCO_3$ gives $\frac{56}{100} \times 90 = 50.4$ g CaO

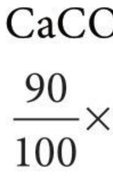
$= 0.90$ mol

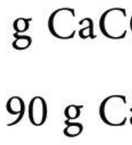
2. (a, c) : Stacking of square close packed layer give rise to *bcc* and simple cubic structure.

3. (b, c, d)

4. (a, c) : (a)  ; $4\pi e^-$ anti-aromatic

(b)  ; $10\pi e^-$ aromatic

(c)  ; $4\pi e^-$ anti-aromatic

(d)  ; $6\pi e^-$ aromatic

5. (a, b, c, d)

6. (a) : $CH_3 - C \equiv \ddot{N}$ behaves both as nucleophile and as an electrophile. The lone pair on N-atom behaves as nucleophilic site whereas the multiple bond between carbon and nitrogen acts as electrophilic site.

7. (6) : Lone pairs in $XeF_2(x) = 3$

Similarly, lone pairs in $XeF_4(y) = 2$

and lone pairs in $XeF_6(z) = 1$

Hence, $x + y + z = 3 + 2 + 1 = 6$

8. (9) : $XeF_6 + 3H_2O \rightarrow \underset{(A)}{XeO_3} + 6HF$

XeO_3 has trigonal pyramidal shape.

$n = 3 \implies n^2 = 9$

9. (50.77) : $2Al + Fe_2O_3 \rightarrow Al_2O_3 + 2Fe$

Molecular mass of fuel mixture ($2Al + Fe_2O_3$)

$= 2 \times 27 + 2 \times 56 + 3 \times 16 = 214$

Total volume of fuel mixture $= \left(\frac{160}{5.2} + \frac{54}{2.7}\right) = 50.77$ mL

10. (3.94) : 50.77 mL of fuel mixture liberates heat $= 200$ kcal

$\therefore$ 1 mL of fuel mixture liberates heat $= \frac{200}{50.77} \times 1$

$= 3.94$ kcal mL^{-1}

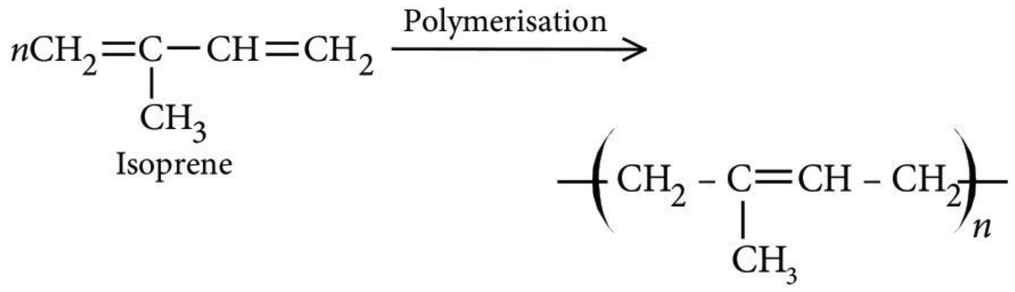
11. (1.9) : $E^\circ_{cell} = \frac{0.059}{n} \log K$ or

$\log K_c = \frac{1.10 \times 2}{0.059} = 37.2881$ or $K_c = 1.9 \times 10^{37}$

12. (20) : $y = 37$

$y - 17 = 20$

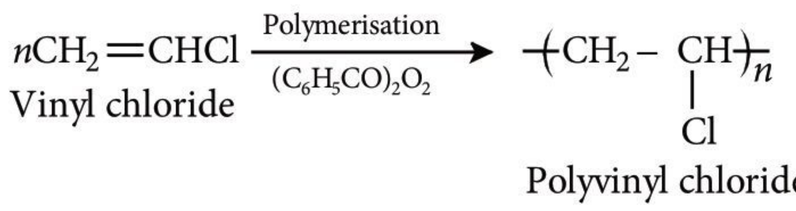
13. (b) : Natural rubber is a hydrocarbon polymer. Its monomer is isoprene.



Isoprene

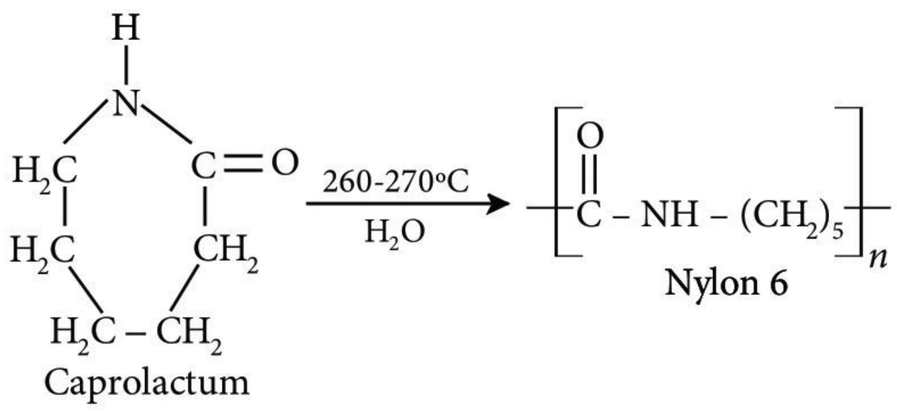
Natural rubber

Polyvinyl chloride, PVC is a thermoplastic homopolymer and is obtained by the polymerisation of vinyl chloride.

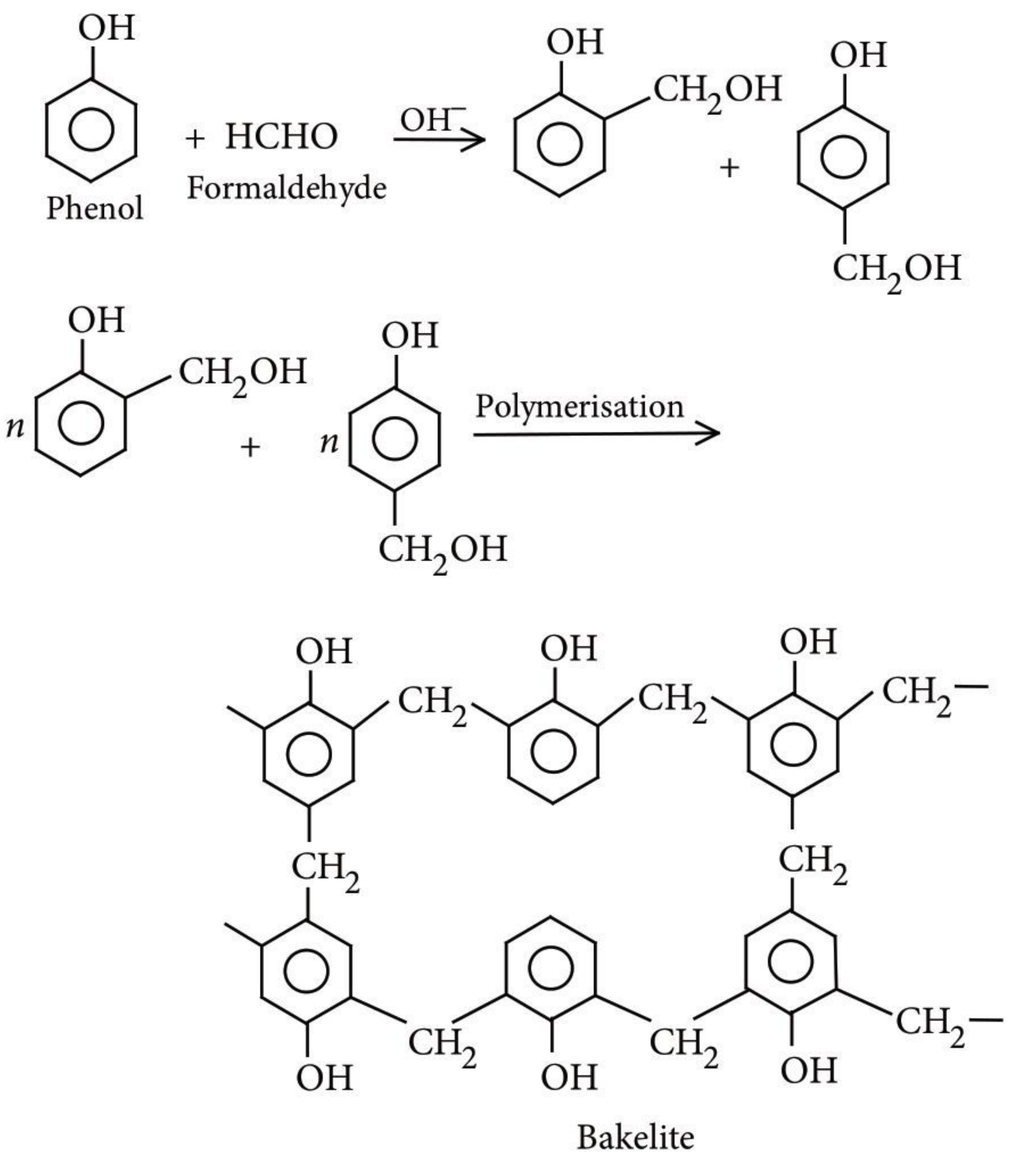


Vinyl chloride Polyvinyl chloride

Nylon-6 is polyamide, which is prepared by prolonged heating of caprolactum at 260-270°C.



Bakelite or phenol formaldehyde resin is obtained by the reaction of phenol and formaldehyde in the presence of a basic catalyst.



14. (c)

15. (c) : First electron affinity is energy releasing process.

16. (a) : Since F has small size, its high electron density resists the addition of an extra electron whereas Cl has bigger size than F, it allows the addition of an extra electron more easily.

17. (7) :

$$2MnO_4^- + 6H^+ + 5SO_3^{2-} \rightarrow 2Mn^{2+} + 5SO_4^{2-} + 3H_2O$$

2 moles 5 moles

5 moles of $SO_3^{2-} \equiv 2$ moles of MnO_4^-

1 mole of $SO_3^{2-} \equiv \frac{2}{5}$ moles of $MnO_4^- \equiv \frac{2}{5}$ moles of MnO_4^-

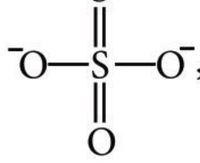
$x + y = 2 + 5 = 7$

18. (2) : $Na_2CO_3 + 2SO_2 + H_2O \rightarrow \underset{(A)}{2NaHSO_3} + CO_2$

$$\underset{(A)}{2NaHSO_3} + Na_2CO_3 \rightarrow \underset{(B)}{2Na_2SO_3} + H_2O + CO_2$$

$$\underset{(B)}{Na_2SO_3} + S \rightarrow \underset{(C)}{Na_2S_2O_3}$$

Structure of $S_2O_3^{2-}$ is



, thus there are 2π-bonds in (C).

19. (2) : Heat of neutralization for strong acid with strong base = – 13.7 kcal/mol

$\Delta H_{(CH_3COOH)} = -12.5 - (-13.7) = +1.2$ kcal/mol

$\Delta H_{(NH_4OH)} = -10.5 - (-13.7) - \Delta H_{(CH_3COOH)}$

$= 13.7 - 10.5 - 1.2 = 2$ kcal/mol

PUBLIC NOTICE JEE ADVANCED 2022 SCHEDULE

S. No.	Activity	Day, Date and Time (IST)
1.	Registration for JEE (Advanced) 2022	Wednesday, June 08, 2022 (10:00 IST) to Tuesday, June 14, 2022 (17:00 IST)
2.	Last date for fee payment of registered candidates	Wednesday, June 15, 2022 (17:00 IST)
3.	Admit Card available for downloading	Monday, June 27, 2022 (10:00 IST) to Sunday, July 03, 2022 (14:30 IST)
4.	Choosing of scribe for PwD candidates	Saturday, July 02, 2022
5.	**JEE (Advanced) 2022**	**Sunday, July 03, 2022** **Paper 1: 09:00-12:00 IST** **Paper 2: 14:30-17:30 IST**
6.	Copy of candidate responses to be available on the JEE (Advanced) 2022 website	Thursday, July 07, 2022 (10:00 IST)
7.	Online display of provisional answer keys	Saturday, July 09, 2022 (10:00 IST)
8.	Feedback and comments on provisional answer keys from the candidates	Saturday, July 09, 2022 (10:00 IST) to Sunday, July 10, 2022 (17:00 IST)
9.	Online declaration of final answer keys	Monday, July 18, 2022 (10:00 IST)
10.	**Result of JEE (Advanced) 2022**	**Monday, July 18, 2022 (10:00 IST)**
11.	Online registration for Architecture Aptitude Test (AAT) 2022	Monday, July 18, 2022 (10:00 IST) to Tuesday, July 19, 2022 (17:00 IST)
12.	Tentative Start of Joint Seat Allocation (JoSAA) 2022 Process	Tuesday, July 19, 2022
13.	Architecture Aptitude Test (AAT) 2022	Thursday, July 21, 2022 (09:00-12:00 IST)
14.	Declaration of results of AAT 2022	Sunday, July 24, 2022 (17:00 IST)

JEE WORK OUTS

Numerical/Integer Value Type Questions

1. An acidified solution of potassium chromate was layered with an equal volume of amyl alcohol. When it was shaken after the addition of 1 mL of 3% H_2O_2, a blue alcohol layer was obtained. The blue colour is due to the formation of a chromium(VI) compound '*X*'. What is the number of oxygen atoms bonded to chromium through only single bonds in a molecule of *X*? **(JEE Advanced 2020)**

2. In a constant volume calorimeter, 3.5 g of a gas with molecular weight 28 was burnt in excess of oxygen at 298 K. The temperature of the calorimeter was found to increase from 298.0 K to 298.45 K due to combustion process. Given that the heat capacity of the calorimeter is 2.5 kJ K^{-1}, the numerical value for the enthalpy of combustion of the gas in kJ mol^{-1} is _____.

3. When 2 g of a gas *A* is introduced into an evacuated flask kept at 25°C, the pressure is found to be one atmosphere. If 3 g of another gas *B* is then added to the same flask, the total pressure becomes 1.5 atm. The ratio of the molecular weights $M_A : M_B$. What is the sum of M_A and M_B considering the simplest ratio of $M_A : M_B$? (Assume ideal gas behaviour.)

4. The density of gold is 19 g /cm^3. If 1.9×10^{-4} g of gold is dispersed in one litre of water to give a sol having spherical gold particles of radius 10 nm, then the number of gold particles per mm^3 of the sol will be _____.

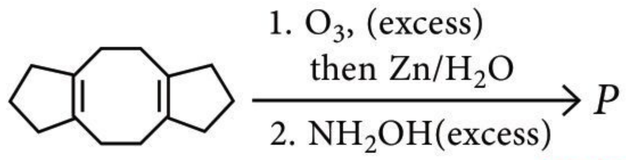
5. Aluminium reacts with sulphuric acid to form aluminium sulphate and hydrogen. What is the volume of hydrogen gas in liters (L) produced at 300 K and 1.0 atm pressure, when 5.4 g of aluminium and 50.0 mL of 5.0 M sulphuric acid are combined for the reaction? (Use molar mass of aluminium as 27.0 g mol^{-1}, R = 0.082 atm L mol^{-1} K^{-1}) **(JEE Advanced 2020)**

6. A solid element (symbol *Y*) conducts electricity and forms two chlorides (YCl_n) (a colourless volatile liquid) and YCl_{n-2} (a colourless solid). To which group of the periodic table does *Y* belong?

7. A compound of a metal ion M^{x+} (Z = 24) has a spin only magnetic moment of $\sqrt{15}$ B.M. The number of unpaired electrons in the metal is _____ .

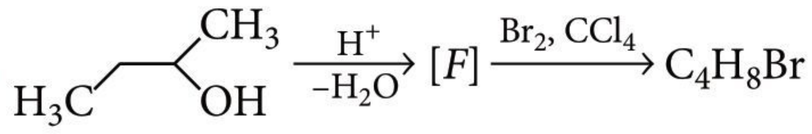
8. The CFSE value of octahedral complex is $-0.6\ \Delta_o$. If metal ion is surrounded by weak field ligands then the magnetic moment can be (spin only) _____ B.M.

9. In the reaction given below, the total number of atoms having sp^2 hybridization in the major product *P* is _____.



(JEE Advanced 2021)

10. The total number of cyclic structural isomers as well as stereoisomers possible for a compound with the molecular formula C_5H_{10} is _____.

11. 

5 such products are possible

How many structures of *F* are possible?

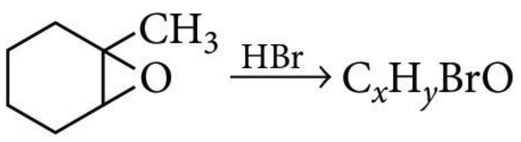
12. 5.00 mL of 0.10 M oxalic acid solution taken in a conical flask is titrated against NaOH from a burette using phenolphthalein indicator. The

volume of NaOH required for the appearance of permanent faint pink colour is tabulated below for five experiments. What is the concentration, in molarity, of the NaOH solution?

Exp. No.	Vol. of NaOH (mL)
1.	12.5
2.	10.5
3.	9.0
4.	9.0
5.	9.0

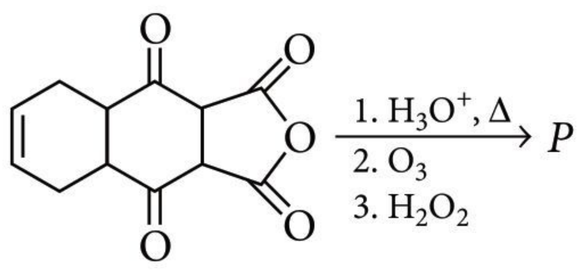
(JEE Advanced 2020)

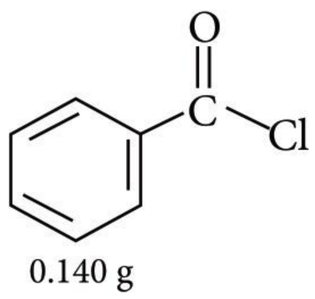
13. How many of the following groups, if substituted at *ortho* and *para* position of chlorobenzene increase its reactivity towards nucleophilic substitution?
$-CN$, $-CH_3$, $-NH(CH_3)$, $-COOH$, $-NO_2$, $-OCH_3$

14. 

What is value of $x \cdot y$?

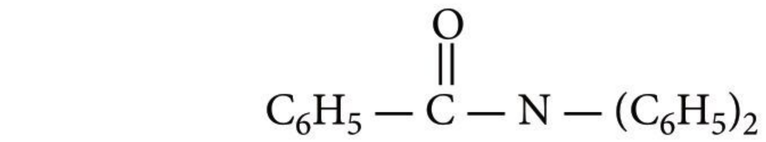
15. The total number of carboxylic acid groups in the product '*P*' is _____.



16. 

0.140 g

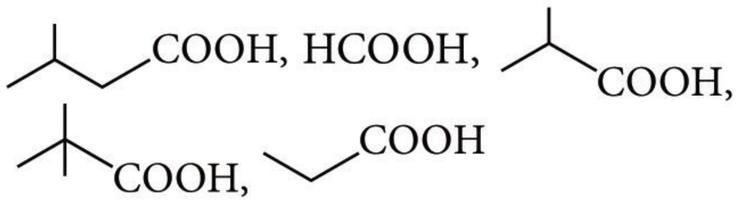
$+ C_6H_5NHC_6H_5 \longrightarrow$
0.388 g



0.210 g

Consider the above reaction. The percentage yield of amide product is _____. (Round off to the nearest integer)
(Given : Atomic mass : C : 12.0 u, H : 1.0 u, N : 14.0 u, O : 16.0 u, Cl : 35.5 u] **(JEE Main 2021)**

17. How many acids will show higher reactivity towards esterification reaction as compared to acetic acid?



18. The number of broad spectrum antibiotics among the following is _____.
Diphenylhydrazine, chloramphenicol, promethazine, chloropheniramine, ofloxacin, vancomycin, chloroxylenol, bithional

19. Consider the reaction :
$Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$
The quantity of electricity in coulombs needed to reduce 1 mol of $Cr_2O_7^{2-}$ is $x \times 96500$ C. What is value of x?

20. A chloro compound "*A*"
(i) forms aldehydes on ozonolysis followed by the hydrolysis.
(ii) when vaporized completely 1.53 g of *A*, gives 448 mL of vapour at STP.
The number of carbon atoms in a molecule of compound *A* is _____. **(JEE Main 2021)**

21. A solution of $Cu(NO_3)_2$ is electrolysed between platinum electrodes using a current of 5 A for 20 minutes. What mass of Cu (in grams) is deposited at the cathode?

22. For a chemical reaction, $A \rightarrow B$, it was found that concentration of *B* is increased by 0.2 mol L^{-1} in 30 min. The average rate of the reaction is _____ $\times 10^{-1}$ mol L^{-1} hr^{-1}. (in nearest integer)

23. On dissolving 0.5 g of a non-volatile non-ionic solute to 39 g of benzene, its vapour pressure decreases from 650 mm Hg to 640 mm Hg. The depression of freezing point of benzene (in K) upon addition of the solute is _____.
(Given data : Molar mass and the molal freezing point depression constant of benzene are 78 g mol^{-1} and 5.12 K kg mol^{-1}, respectively)
(JEE Advanced 2019)

24. The reaction : $2A + B_2 \rightarrow 2AB$ is an elementary reaction. For a certain quantity of reactants, if the volume of the reaction vessel is reduced by a factor of 3, the rate of the reaction increases by a factor of _____. (Round off to the nearest integer)

Quotable Quote

"Try not to become a man of SUCCESS but rather try to become a man of VALUE"

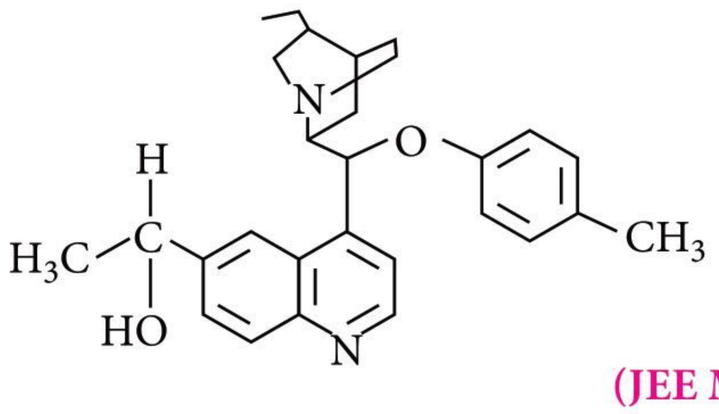
Albert Einstein

25. What is the concentration of H_2O_2 solution (in mol L^{-1}), when 20 mL of H_2O_2 will react completely with 10 mL of 2 M $KMnO_4$ in acidic medium?

26. Consider the following species and find out total number of species which are polar and can also act as Lewis acid:
CCl_4, CO_2, SO_2, $AlCl_3$, HCHO, SO_3, $SiCl_4$, BCl_3, CF_4

27. The Azimuthal quantum number for the valence electrons of Ga^+ ion is _____.
(Atomic number of Ga = 31)

28. The number of chiral carbons present in the molecule given below is _____.



(JEE Main 2020)

29. The work function of sodium metal is 4.41×10^{-19} J. If photons of wavelength 300 nm are incident on the metal, the kinetic energy of the ejected electrons will be _____ $\times 10^{-21}$ J.
($h = 6.63 \times 10^{-34}$ Js; $c = 3 \times 10^8$ m/s)

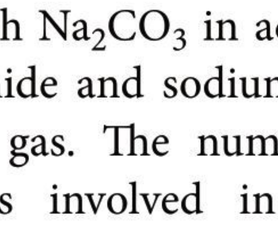
30. Reaction of Br_2 with Na_2CO_3 in aqueous solution gives sodium bromide and sodium bromate with evolution of CO_2 gas. The number of sodium bromide molecules involved in the balanced chemical equation is _____.

SOLUTIONS

1. (4): If an acidic solution of chromate ion (CrO_4^{2-}) is treated with H_2O_2, a deep blue solution of chromium pentaoxide (CrO_5) is obtained.

$$CrO_4^{2-} + 2H^+ + 2H_2O_2 \longrightarrow \underset{\substack{\text{Chromium (VI)}\\ \text{compound } (X)\\ \text{(deep blue}\\ \text{coloured solution)}}}{CrO_5} + 3H_2O$$

The structure of CrO_5 is



Thus, the number of O-atoms bonded to chromium through single bonds in CrO_5 is 4.

2. (9): Given, $C_v = 2.5$ kJ $K^{-1} = 2500$ J K^{-1}
$\Delta T = T_2 - T_1 = 298.45 - 298 = 0.45$ K
ΔH due to combustion of 3.5 g gas = $C_v \times \Delta T$
$= 2500 \times 0.45 = 1125$ J
Given, molecular weight of gas = 28 g
$\therefore$ 28 g $\equiv$ 1 mole
Hence, ΔH due to combustion of 1 mole of gas

$$= \frac{1125}{3.5} \times 28$$

$= 9000$ J mol^{-1} or 9 kJ mol^{-1}

3. (4): Given, weight of gas A = 2 g
Pressure of A = 1 atm, T = 298 K
Now, another gas is introduced.
Weight of B = 3 g
Pressure of mixture = 1.5 atm
From Dalton's law of partial pressure,
$P_m = P'_A + P'_B$; $1.5 = 1.0 + P'_B$; $P'_B = 0.5$ atm

For A, $P'_A \times V = \frac{2}{M_A} \times RT$

For B, $P'_B \times V = \frac{3}{M_B} \times RT$

$$\frac{P'_A}{P'_B} = \frac{2}{3} \times \frac{M_B}{M_A}$$

$$\frac{M_A}{M_B} = \frac{2}{3} \times \frac{P'_B}{P'_A} \Rightarrow \frac{2}{3} \times \frac{0.5}{1.0}$$

$$\frac{M_A}{M_B} = \frac{1}{3} \Rightarrow M_A : M_B = 1 : 3, M_A + M_B = 1 + 3 = 4$$

4. (2380000) : Volume of gold dispersed in one litre H_2O

$$= \frac{\text{Mass}}{\text{Density}} = \frac{1.9 \times 10^{-4}\,\text{g}}{19\,\text{g/cm}^3} = 1 \times 10^{-5}\ \text{cm}^3$$

Radius of gold sol particle = 10 nm = 10^{-6} cm

Volume of the gold sol particle = $\frac{4}{3}\pi r^3$

$$= \frac{4}{3} \times \frac{22}{7} \times (10^{-7})^3 = 4.19 \times 10^{-21}\ \text{cm}^3$$

No. of gold sol particles in 1×10^{-5} cm^3 = $\frac{1 \times 10^{-5}}{4.19 \times 10^{-18}}$
$= 2.38 \times 10^{12}$

No. of gold sol particles in 1 mm^3 = $\frac{2.38 \times 10^{12}}{10^6}$
$= 2.38 \times 10^6 = 2380000$

5. (6.15) : Given : T = 300 K, P = 1 atm, w_{Al} = 5.4 g
$M_{H_2SO_4}$ = 5.0 M, $V_{H_2SO_4}$ = 50.0 mL

$$\underset{\substack{2\text{ moles}\\ \left(\frac{5.4}{27}\right.\\ \left.=0.2\text{ mol}\right)}}{2Al} + \underset{\substack{3\text{ moles}\\ \left(\frac{5}{1000}\times 50\right.\\ \left.=0.25\text{ mol}\right)}}{3H_2SO_4} \longrightarrow \underset{}{Al_2(SO_4)_3} + \underset{3\text{ moles}}{3H_2}$$

Thus, for 2 moles of Al, 3 moles of H_2SO_4 is required *i.e.*, for 0.2 mol of Al, 0.3 mol of H_2SO_4 is required but the moles of H_2SO_4 available is 0.25 mol thus, H_2SO_4 is the limiting reagent. So, 0.25 mol of H_2 will be produced *i.e.*, $n = 0.25$ mol.

$PV = nRT$

$1 \times V = 0.25 \times 0.082 \times 300 \Rightarrow V = 6.15$ L

6. (14) : Element *Y* can probably be tin which conducts electricity and belongs to group 14.

$SnCl_4$ is colourless volatile liquid whereas $SnCl_2$ is colourless solid.

7. (3) : Spin only magnetic moment, $\mu = \sqrt{n(n+2)}$ where, n = no. of unpaired electrons.

Given, $\mu = \sqrt{n(n+2)} = \sqrt{15}$

$n(n+2) = 15 \Rightarrow n = 3$

8. (4.9) : CFSE $= -0.4x + 0.6y$

($x \downarrow t_{2g}$, $y \downarrow e_g$)

CFSE is $-0.6\,\Delta_o$ (*i.e.*, $-0.4 \times 3 + 0.6 \times 1$

$= -1.2 + 0.6 = -0.6\Delta_o$)

$\Rightarrow$ It is d^4 system.

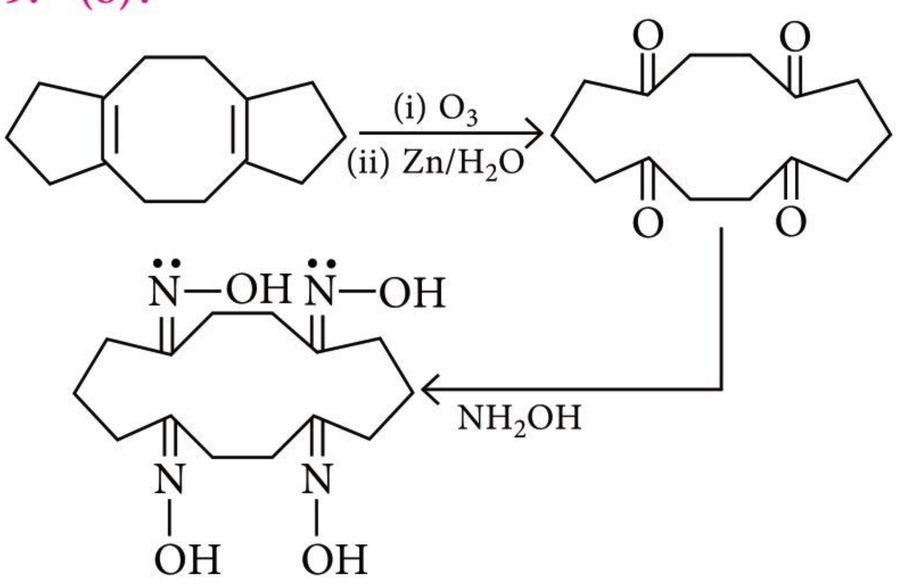
Because ligand is weak field, no pairing of electrons occurs.

$\therefore$ No. of unpaired electrons = 4

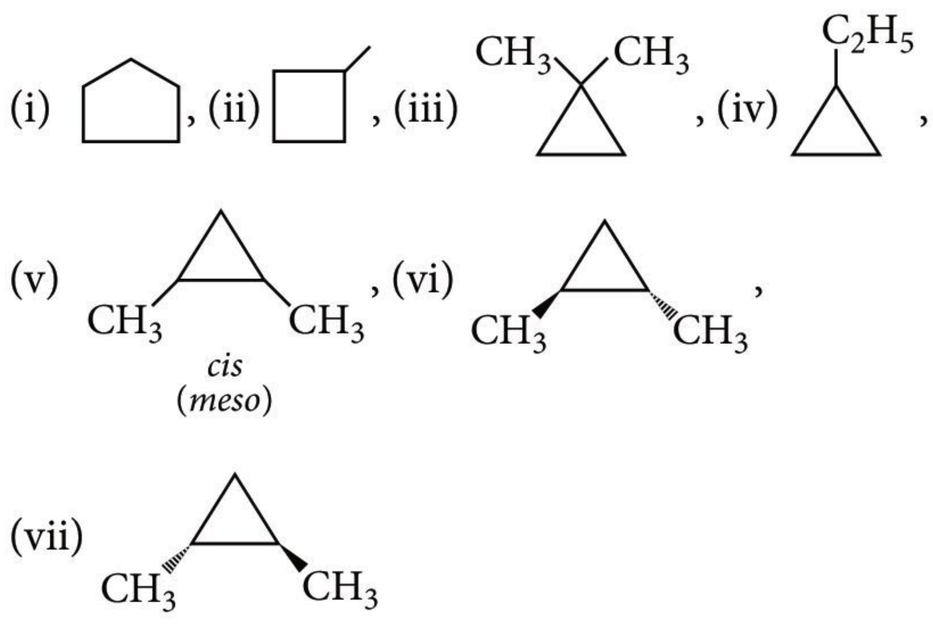
Magnetic moment $(\mu) = \sqrt{n(n+2)}$ B.M.

$= \sqrt{4(4+2)} = \sqrt{24}$; $\mu = 4.9$ B.M.

9. (8):

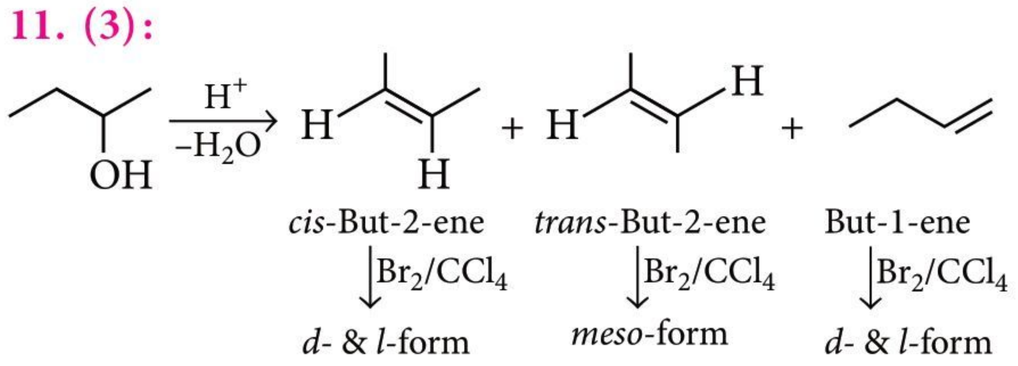


10. (7): For a compound with molecular formula C_5H_{10}, the isomers are as follows :



Structure (vi) and (vii) are *trans*-isomers and are same. It can exist in *d* and *l*-forms.

11. (3):



12. (0.11) : Given : $M_1 = 0.10$ M, $V_1 = 5.00$ mL,

$M_2 = ?$, $V_2 = 9.0$ mL

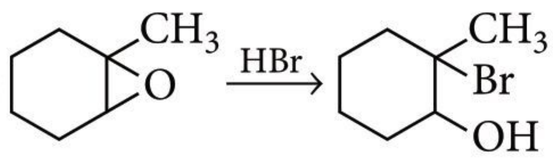
$$(M_1V_1)_{\text{oxalic acid}} = \frac{1}{2} \times (M_2V_2)_{\text{NaOH}}$$

$$0.10 \times 5.00 = \frac{1}{2} \times (M_2 \times 9.0)$$

$$M_2 = \frac{2 \times 0.10 \times 5.00}{9.0} = 0.11\,\text{M}$$

13. (3): $-CN$, $-COOH$, $-NO_2$

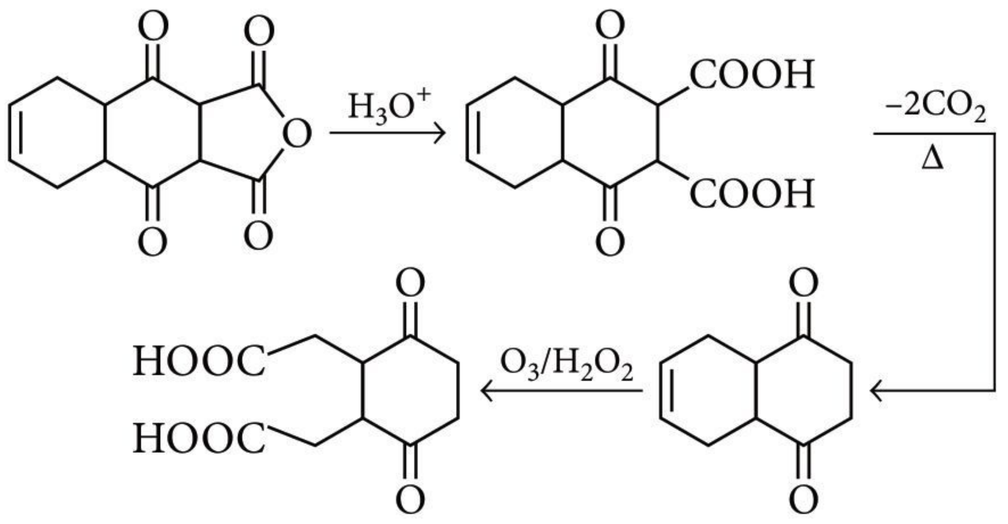
14. (91) :



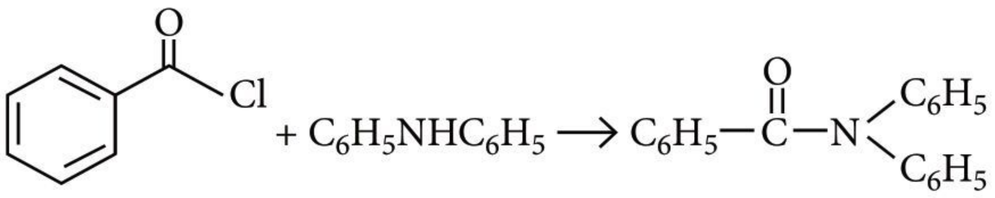
$x = 7, y = 13$

$\Rightarrow x \cdot y = 13 \times 7 = 91$

15. (2):



16. (77) :



0.140 g + 0.388 g → 0.210 g

$= \frac{0.14}{140.5}$ $= \frac{0.388}{169}$

$= 10^{-3}$ mol $= 2.29 \times 10^{-3}$ mol

Here, benzoyl chloride is limiting reagent.

140.5 g of benzoyl chloride gives = 273 g amide

0.140 g of benzoyl chloride gives $= \frac{273}{140.5} \times 0.140$ g amide

$= 0.273$ g amide

Theoretical yield = 0.273 g

Experimental yield = 0.210 g

$$\% \text{ yield} = \frac{\text{Experimental yield}}{\text{Theoretical yield}} \times 100$$

$$\% \text{ yield} = \frac{0.210}{0.273} \times 100 = 76.92 \approx 77\%$$

17. (1): The order of reactivity of carboxylic acids towards esterification reaction is $HCOOH > CH_3COOH > RCH_2COOH > R_2CHCOOH > R_3CCOOH$.

18. (3): Chloramphenicol, ofloxacin and vancomycin are broad spectrum antibiotics.

19. (6): 1 mole of $Cr_2O_7^{2-}$ requires 6 moles of electrons for reduction.

$\therefore$ Required charge = 6 × faraday = 6 × 96500 C

20. (3): 448 mL vapour come from 1.53 g

22400 mL of vapours will come from $\frac{1.53}{448} \times 22400$

$= 76.5$ g

Thus, the molecular weight of *A* is 76.5 g. The compound must contain one Cl and one C=C bond. Hence, the compound will be $CH_3 - CH = CH - Cl$.

Number of C atoms = 3

21. (1.97) : $Cu(NO_3)_2 \longrightarrow Cu^{2+} + 2NO_3^-$

At cathode : $Cu^{2+} + 2e^- \longrightarrow Cu$

For getting 1 mole of Cu, we require 2 faraday of electricity.

$I = 5$A, $t = 20$ min $= 20 \times 60 = 1200$ s

$Q = I \times t = 5 \times 1200 = 6000$ C

2×96500 C of electricity will produce 63.5 g of Cu

6000 C of electricity will produce $= \frac{63.5 \times 6000}{2 \times 96500}$

$= 1.97$ g of Cu

22. (4):

	$A \longrightarrow$	B
$t = 0$	a	0
$t = 30$ min	$(a - x)$	$x = 0.2$ mol/L^{-1}

Average rate $= \frac{d[B]}{dt} = \frac{0.2 \text{ mol L}^{-1}}{0.5 \text{ hour}}$

$= 0.4$ mol L^{-1} hr^{-1} $= 4 \times 10^{-1}$ mol L^{-1} hr^{-1}

23. (1.03) : $\frac{p^o - p_s}{p_s} = i\left[\frac{n_{\text{solute}}}{n_{\text{solvent}}}\right]$

$$\frac{650-640}{640} = 1 \times \frac{0.5 \times 78}{M \times 39} \Rightarrow M_{\text{solute}} = 64 \text{ g}$$

$$\Delta T_f = K_f \times m = 5.12 \times \frac{0.5 \times 1000}{64 \times 39} \Rightarrow \Delta T_f = 1.03 \text{ K}$$

24. (27) : For an elementary reaction given,

Rate $= k\,[A]^2\,[B_2] \Rightarrow R = k[A]^2\,[B_2]$

On decreasing volume, concentration increases.

So, rate after decreasing volume, $R' = k\,[3A]^2\,[3B_2]$

$R' = k\,3^3\,[A]^2[B_2]$; $R' = 27\,k[A]^2\,[B_2] \Rightarrow R' = 27R$

25. (2.5) : $H_2O_2 + KMnO_4 \longrightarrow Mn^{2+} + O_2$ ($n_f = 2$ for H_2O_2; $n_f = 5$ for $KMnO_4$)

$n_{eq}\,(H_2O_2) = n_{eq}\,(KMnO_4)$

$M \times 20 \times 2 = 2 \times 10 \times 5 \Rightarrow M = 2.5$ M

26. (2): SO_2 and HCHO are polar in nature and can also act as Lewis acid.

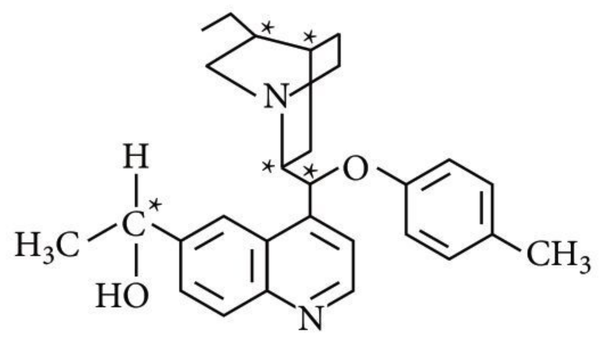
27. (0): Ga : $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,3d^{10}\,4s^2\,4p^1$

Ga^+ : $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,3d^{10}\,4s^2$

Valence electron is in *s*-orbital.

So, azimuthal quantum number (l) for valence shell electron is 0.

28. (5):



29. (222): Given : $w_0 = 4.41 \times 10^{-19}$ J, $\lambda = 300$ nm

K.E. = ?, $h = 6.63 \times 10^{-34}$ Js, $c = 3 \times 10^8$ m s^{-1}

$w_0 = h\upsilon - K.E.$

$$4.41 \times 10^{-19} \text{ J} = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{300 \times 10^{-9}} - K.E.$$

$$4.41 \times 10^{-19} \text{ J} = \frac{19.89 \times 10^{-26}}{300 \times 10^{-9}} - K.E.$$

4.41×10^{-19} J $= 6.63 \times 10^{-19} - K.E.$

$K.E. = 6.63 \times 10^{-19} - 4.41 \times 10^{-19}$

$= 2.22 \times 10^{-19}$ J $= 222 \times 10^{-21}$ J

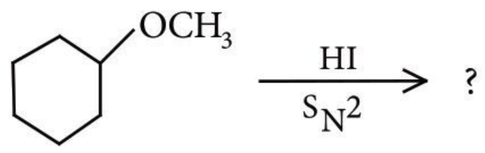
30. (5): $3Br_2 + 3Na_2CO_3 \longrightarrow 5NaBr + NaBrO_3 + 3CO_2$

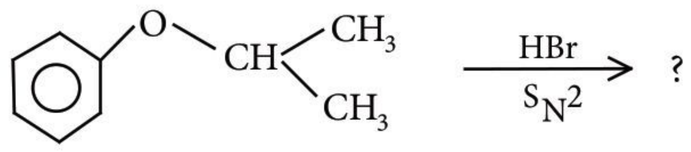
So, no. of NaBr molecules = 5.

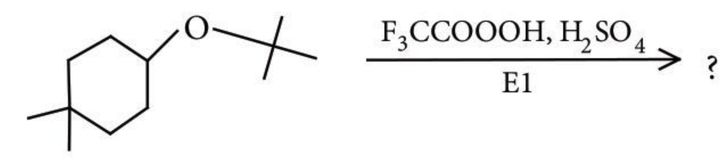
ORGANIC CHEMISTRY
PROBLEM SOLVING APPROACH

PROBLEMS

1. Write the products of the following reactions.

(a) 

(b) 

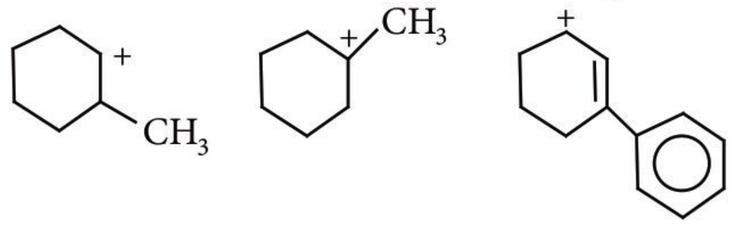
(c) 

2. How will you synthesize?
(i) Acetamide from acetone
(ii) Iodoform from acetic acid
(iii) Malonic acid from acetic acid
(iv) Crotonic acid from acetaldehyde

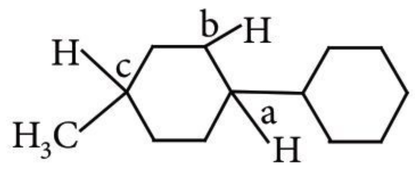
3. A compound (*A*), $C_8H_{14}O_2$ on reduction with lithium aluminium hydride yielded two compounds (*B*) and (*C*). The compound (*B*) on oxidation gave (*D*), which on treatment with aqueous alkali and subsequent heating furnished (*E*). (*E*) on further treatment with iodine and alkali followed by acidification furnished (*F*) and a yellow precipitate of CHI_3. The methyl ester of (*F*) on lithium aluminium hydride reduction gave compound (*C*) along with methanol. The compound (*D*) can be obtained by the action of dimethyl cadmium reagent on an acid chloride having molecular formula weight 78.5. Deduce the structures of (*A*), (*B*), (*C*), (*D*), (*E*) and (*F*), showing all the reactions involved?

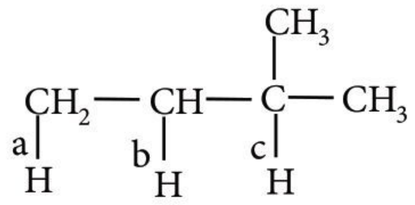
4. Arrange the following in increasing order of stability.

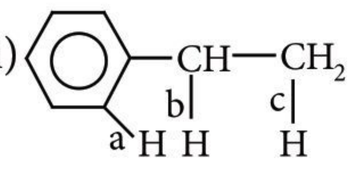
(i) 

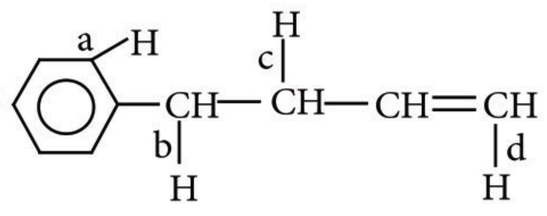
(ii) 

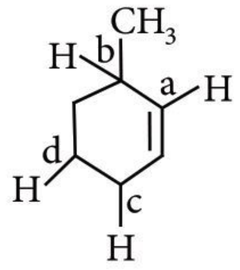
5. Arrange the bond energies of C—H bond indicated by a, b, c and d.

(i) 

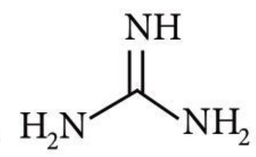
(ii) 

(iii) 

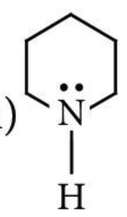
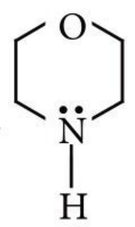
(iv) 

(v) 

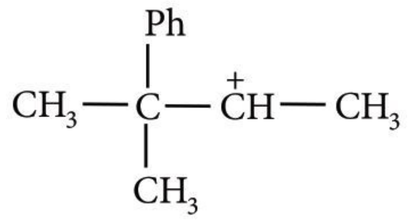
6. Give reasons for the following.

(i) Guanidine,  is more basic than $(CH_3)_2C{=}NH$

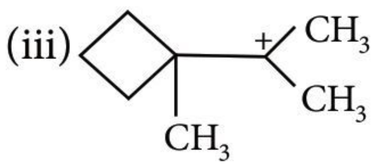
(ii) Pyridine, $C_5H_5\ddot{N}$ is more basic than pyrrole C_4H_5N.

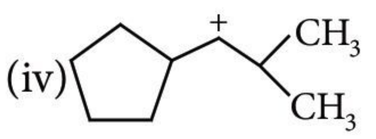
(iii)  is more basic than 

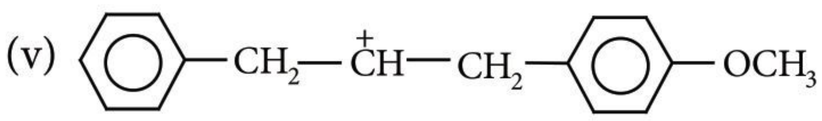
7. Predict whether rearrangement is possible or not for the following intermediates. If yes, write rearranged products.

(i) 

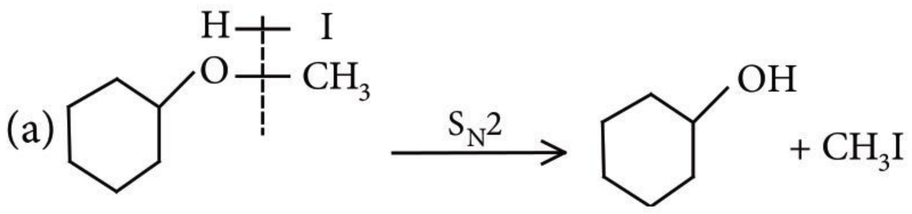
(ii) $(CH_3)_3C-\overset{+}{C}H-C(CH_3)_3$

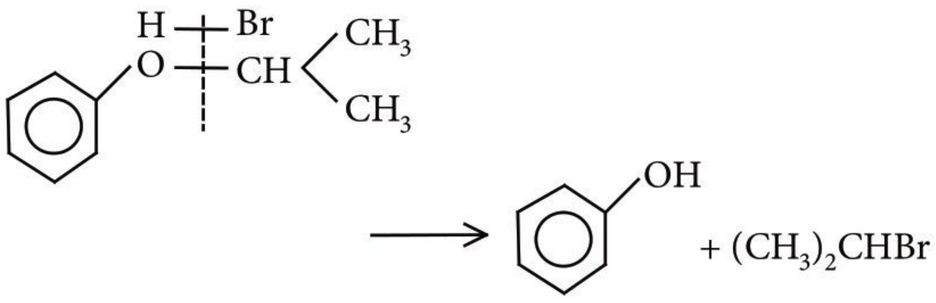
(iii) 

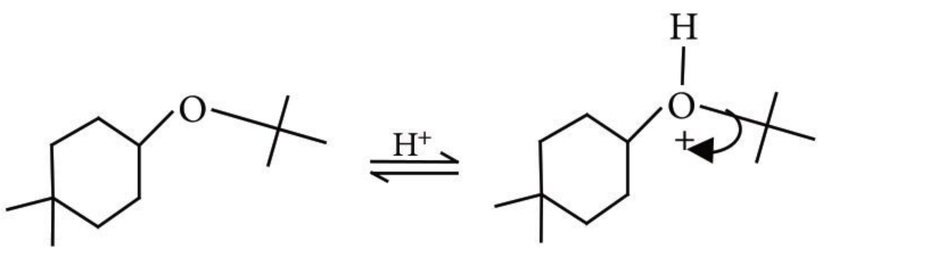
(iv) 

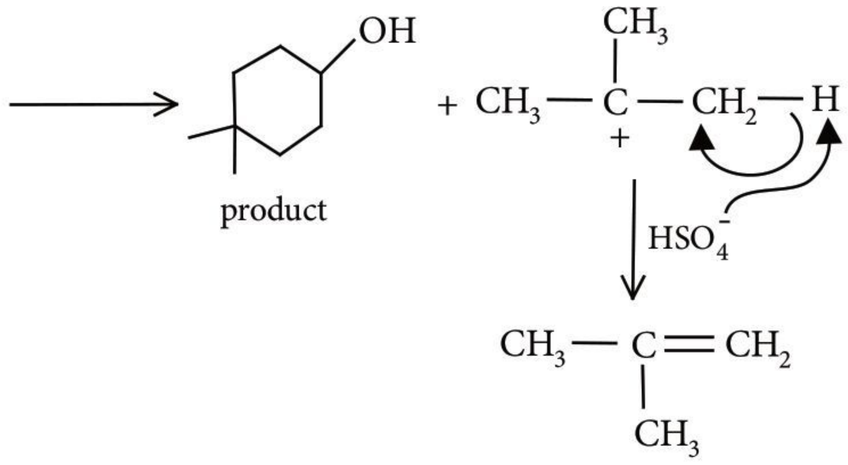
(v) 

SOLUTIONS

1. (a) 

(b) 

(c) 



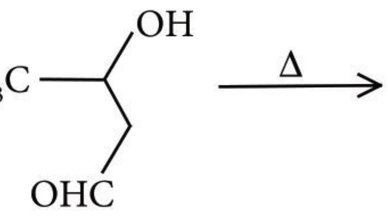
2. (i) $CH_3COCH_3 \xrightarrow{I_2/OH^-} CH_3COONa \xrightarrow{H^+}$

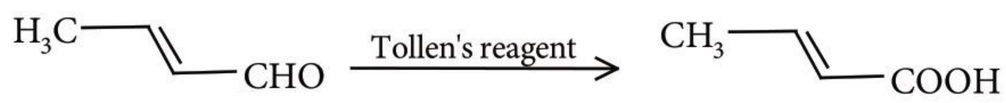
$CH_3COOH \xrightarrow{NH_3} CH_3COO^-NH_4^+ \xrightarrow{\Delta} CH_3CONH_2$

(ii) $CH_3COOH \xrightarrow{Ca(OH)_2} (CH_3COO)_2Ca \xrightarrow{\Delta}$

$CH_3COCH_3 \xrightarrow{I_2/OH^-} CHI_3$

(iii) $CH_3COOH \xrightarrow{Br_2/P}$ $\xrightarrow{KCN}$

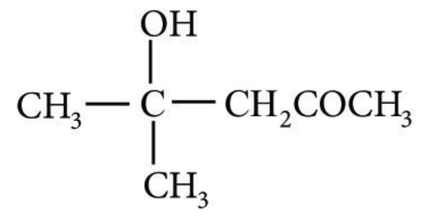
(iv) $2CH_3CHO \xrightarrow{\text{dil. } OH^-}$  $\xrightarrow{\Delta}$



3. $(CH_3)_2C=CH-\overset{O}{\overset{\|}{C}}-OCH(CH_3)_2 \xrightarrow{LiAlH_4}$ (*A*)

$(CH_3)_2C=CH-CH_2-OH + (CH_3)_2CHOH \xrightarrow{[O]}$

(*C*) (*B*)

$2CH_3-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow{\bar{O}H}$ 

(*D*)

$\xrightarrow[-H_2O]{\Delta} (CH_3)_2C=CH-\overset{O}{\overset{\|}{C}}-CH_3$ (*E*)

$\xrightarrow{I_2/OH^-, H^+} (CH_3)_2C=CH-COOH + CHI_3$ (*F*)

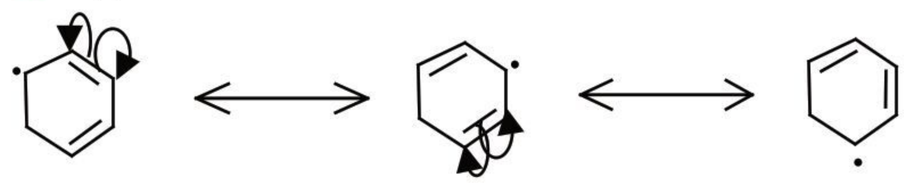
$(CH_3)_2C=CH-COOMe \xrightarrow{LiAlH_4}$

$(CH_3)_2C=CH-CH_2OH + CH_3OH$ (*C*)

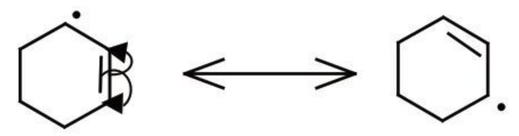
$2CH_3COCl + (CH_3)_2Cd \longrightarrow 2CH_3COCH_3 + CdCl_2$

(M = 78.5) (*D*)

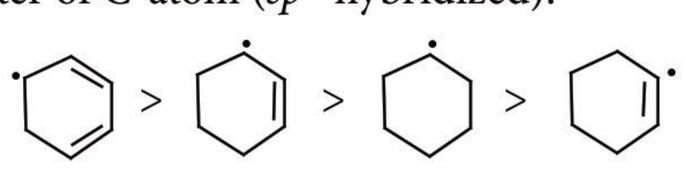
4. (i) Resonance stabilizes free radical.

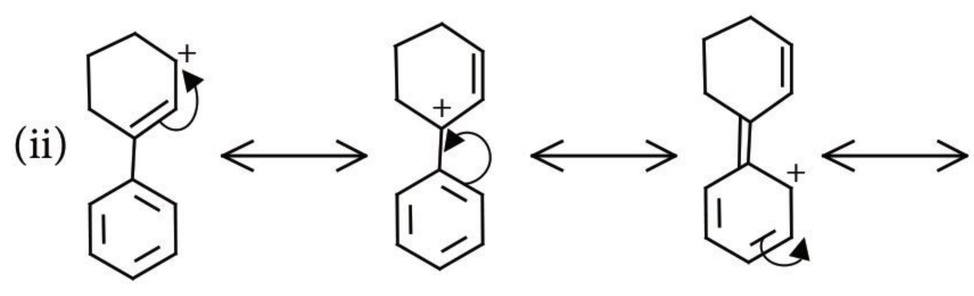


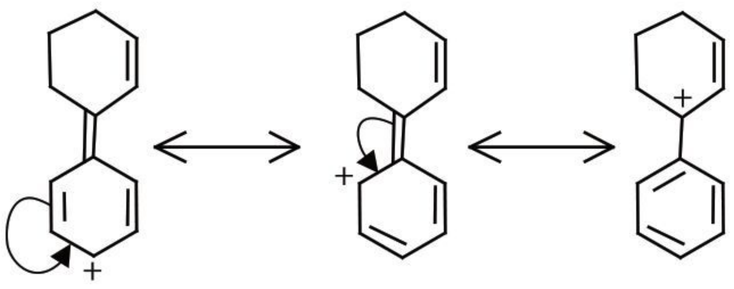
More number of resonating structures, more is the stability.



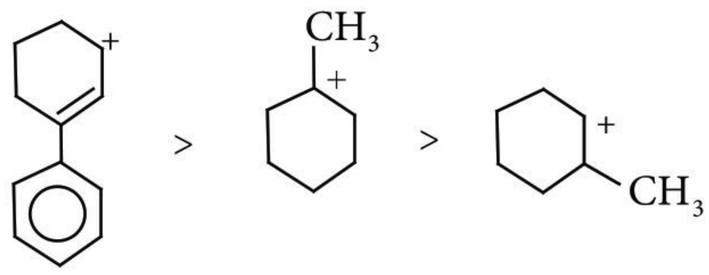
Moreover, vinylic radical is least stable, due to more *s*-character of C-atom (sp^2-hybridized).



(ii) 



Thus,



Resonance stabalized

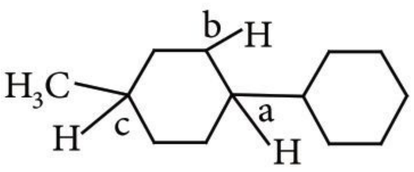
3° cation

2° cation

5. As far as the radical stability is concerned,

benzylic > allylic > 3° > 2° > 1° > methyl radical > vinyl > phenylic.

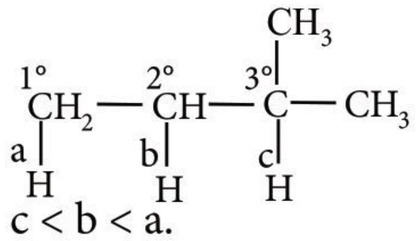
Therefore (i)



The C—H bond which produces more stable free radical breaks easily thus bond energy of c < a < b

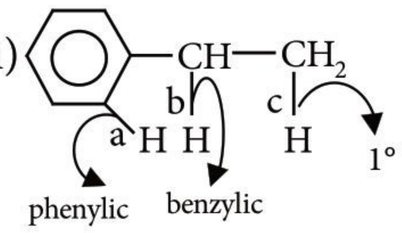
3° 3° 2°

(ii)



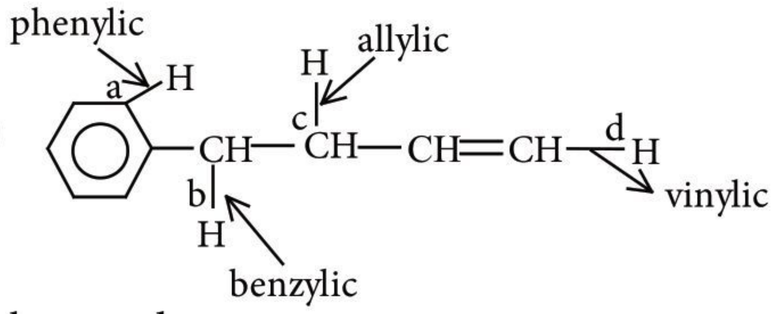
$\therefore$ c < b < a.

(iii)



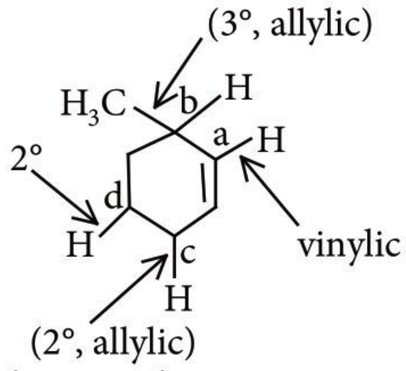
$\therefore$ b < c < a

(iv)



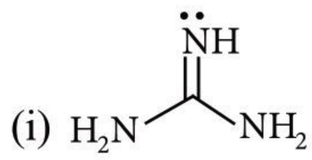
$\therefore$ b < c < d < a

(v)

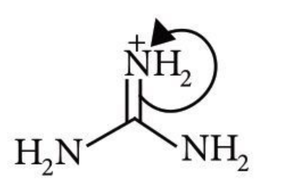


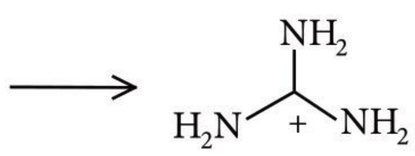
$\therefore$ b < c < d < a

6. (i)

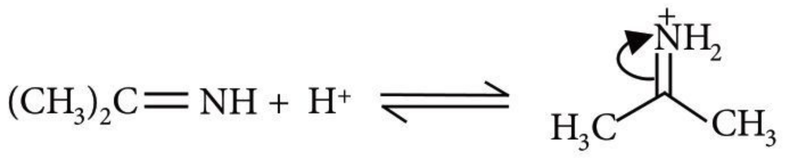


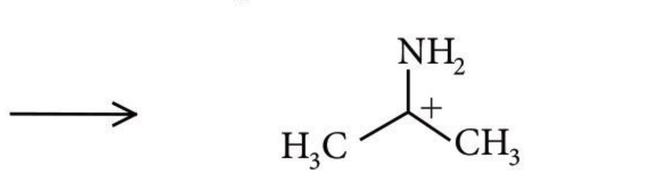
Guanidine





Carbocation highly stable due to three +M effects of NH_2 groups (all resonating structures are identical)





2° carbocation (also stabilised by NH_2)

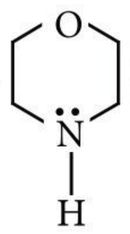
In guanidine + *M* effect of two nitrogen increases electron density on 3rd nitrogen thus it is more basic than $(CH_3)_2C = NH$.

(ii) In pyridine the lone pair of electrons on nitrogen are localised and do not participate in the cyclic delocalization whereas in pyrrole, the lone pair of electrons freely participates in delocalization. So the lone pair of electron on nitrogen of pyridine are readily available for the donation.

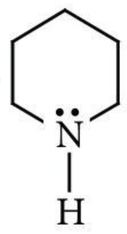
Pyridine

Pyrrole

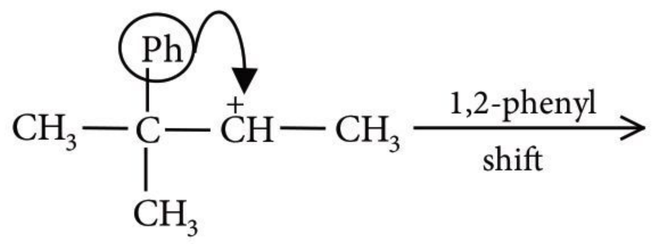
(iii) Due to the –*I* effect of oxygen atom,



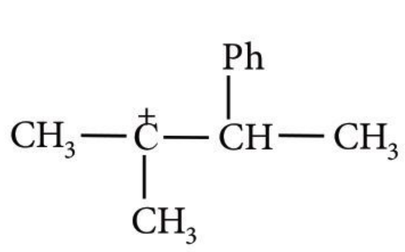
is less basic than



7. (i)



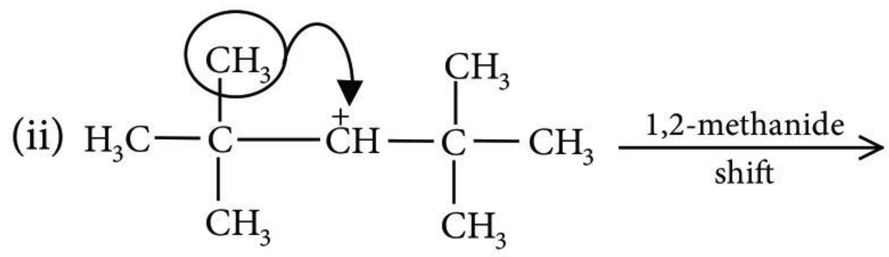
2° carbocation



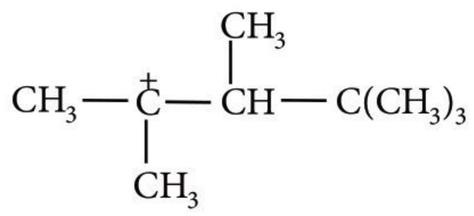
3° carbocation

Phenyl shift is preferable over methyl shift.

(ii)

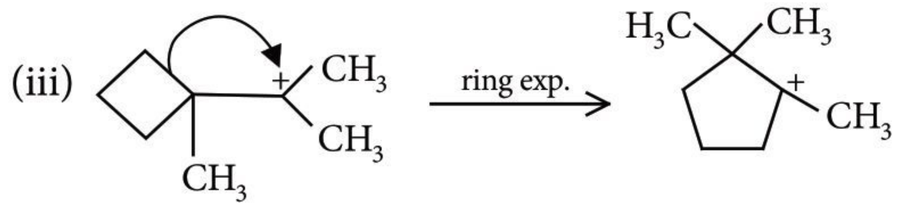


2° carbocation

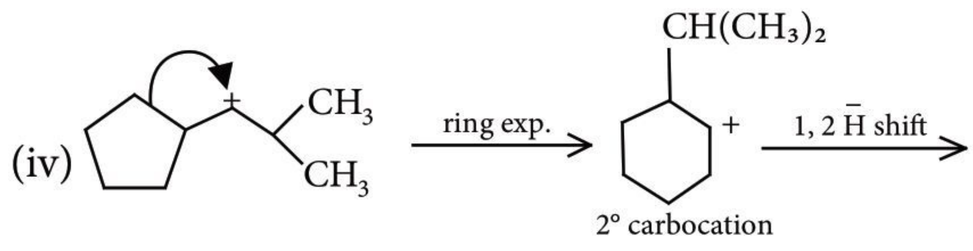


3° carbocation

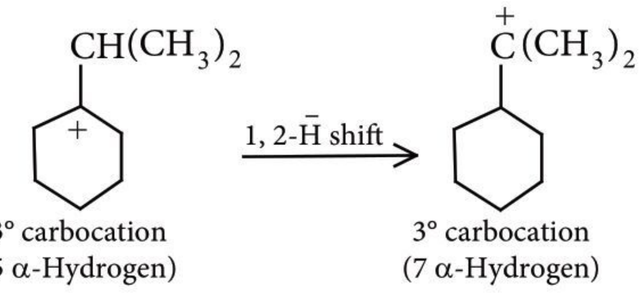
(iii)



(iv)



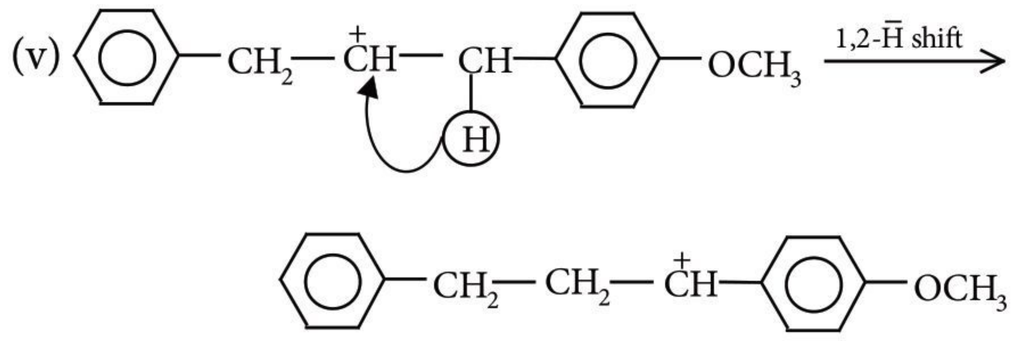
2° carbocation



3° carbocation
(5 α-Hydrogen)

3° carbocation
(7 α-Hydrogen)

(v)



(OCH_3 shows +*M* effect and stabilise carbocation)

EXAM ALERT 2022

Exam	Date
JEE Main	Session 1 : 21st, 24th, 25th, 29th April and 1st, 4th May Session 2 : 24th to 29th May
JEE Advanced	3rd July
SRMJEEE	Phase 2 : 23rd and 24th April Phase 3 : 25th and 26th June
WB JEE	23rd April

OLYMPIAD PROBLEMS

1. Niobium crystallizes in body centred cubic structure. If its density is 8.55 g cm^{-3}, calculate the atomic radius of niobium. (At. wt. of niobium = 93)

(a) 1.43×10^{-8} cm (b) 1.478×10^{-8} cm

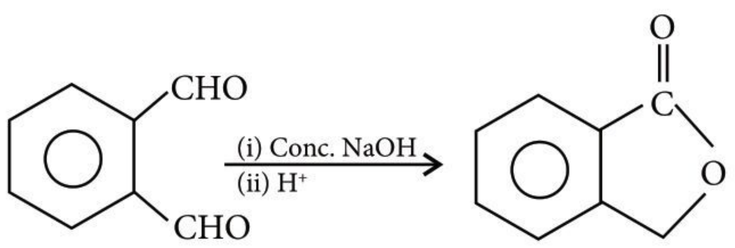
(c) 1.43×10^{-10} cm (d) 1.43×10^{-6} cm

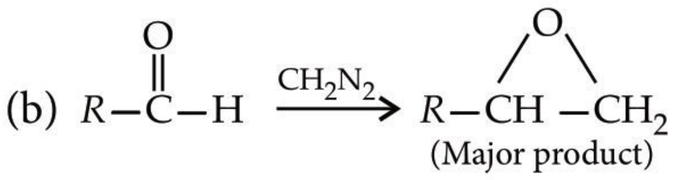
2. Out of N_2O, SO_2, I_3^+, I_3^-, H_2O, NO_2^- and N_3^-, the linear species are

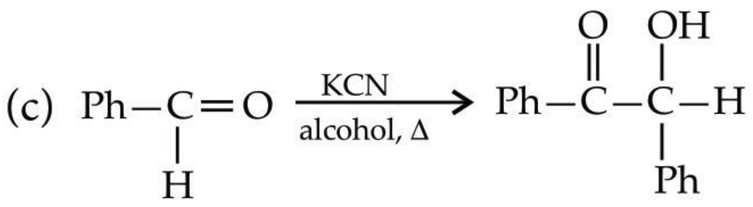
(a) NO_2^-, I_3^+, H_2O (b) N_2O, I_3^+, N_3^-

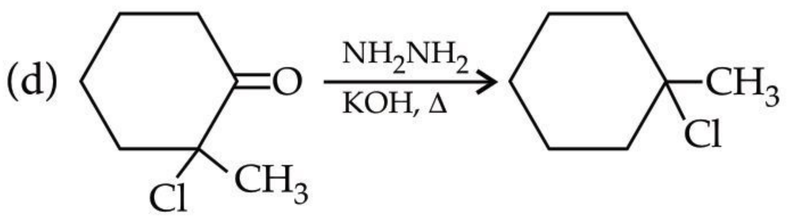
(c) N_2O, I_3^-, N_3^- (d) N_3^-, I_3^+, SO_2

3. Which of the following products is incorrectly shown?

(a) 

(b) 

(c) 

(d) 

4. Which of the following mixtures will have the lowest pH at 298 K?

(a) 10 mL 0.05 N CH_3COOH + 5 mL 0.1 N NH_4OH

(b) 5 mL 0.2 N NH_4Cl + 5 mL 0.2 N NH_4OH

(c) 5 mL 0.1 N CH_3COOH + 10 mL 0.05 N CH_3COONa

(d) 5 mL 0.1 N CH_3COOH + 5mL 0.1 N NaOH

5. Consider the rate law expression for a reaction : rate = $k[NO_2^-][I^-][H^+]^2$ and select the incorrect option.

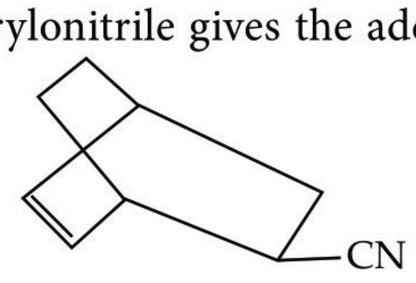
(a) When concentrations of both NO_2^- and I^- are doubled rate becomes 4 times.

(b) When concentration of H^+ is tripled, rate becomes nine times.

(c) When concentration of each of H^+, NO_2^- and I^- are tripled, rate becomes nine times.

(d) When concentration of NO_2^- is doubled, I^- is halved and H^+ is doubled, rate becomes 4 times.

6. The Diels—Alder reaction between 1,3-cyclohexadiene and acrylonitrile gives the adduct,



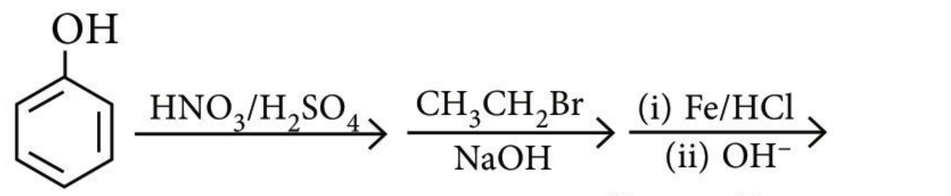
Its IUPAC name is

(a) bicyclo [2.2.2] oct-2-en-5-nitrile

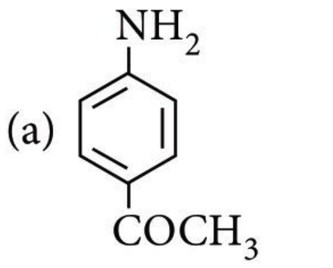
(b) bicyclo [2.2.2] oct-5-en-2-carbonitrile

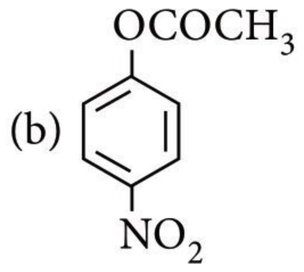
(c) 3-cyano bicyclo [2.2.2] oct-5-ene

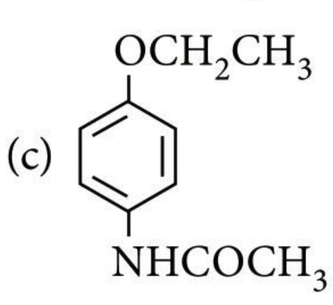
(d) 2-cyano bicyclo [2.2.2] oct-5-ene.

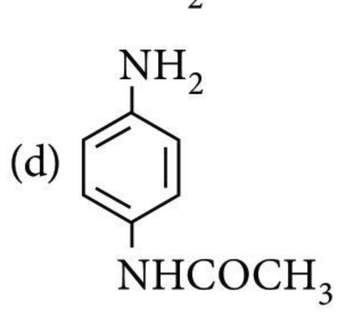
7. 

Product *P* is an analgesic. Its structure will be

(a) 

(b) 

(c) 

(d) 

8. Which of the following is in the incorrect order?

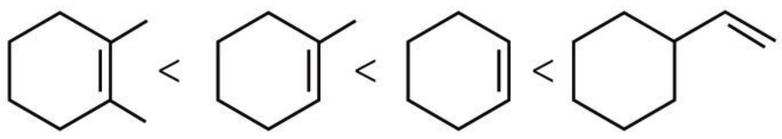
(a) $CH_3\bar{S} > CH_3\bar{O} > H\bar{O} > H_2O$

(b) $\bar{Cl} > \bar{O}-\underset{\underset{O}{\|}}{C}-CH_3 > \bar{O}CH_3 > \bar{N}H_2$

(nucleophilicity in protic solvent)

(leaving group ability)

(c) $CH_3-CH_2-F > CH_3-CH_2-Cl > CH_3-CH_2-Br > CH_3-CH_2-I$ (boiling point)

(d)  (rate of catalytic hydrogenation)

9. A beaker containing 20 g sugar in 100 g water and another containing 10 g sugar in 100 g water are placed under a bell-jar and allowed to stand until equilibrium is reached. The amount of water which will be transferred from one beaker to other is

(a) 11.0 g (b) 20 g

(c) 33.3 g (d) 066.7 g.

10. Calculate the emf of the cell,

$Ag_{(s)}, AgIO_{3(s)}|Ag^+(xM), HIO_3(1M)||Zn^{2+}(1M)|\ Zn_{(s)}$

If $K_{sp} = 3 \times 10^{-8}$ for $AgIO_3$ and $K_a = \frac{1}{6}$ for HIO_3 and E°_{cell} for $2Ag + Zn^{2+} \longrightarrow 2Ag^+ + Zn$ is – 1.56 V

(Given : log 3 = 0.48, $\frac{2.303\ RT}{F} = 0.06$)

(a) – 1.137 V (b) – 1.56 V

(c) – 1.44 V (d) – 1.37 V

11. For Mn^{3+} pairing energy is 28000 cm^{-1}, Δ_o for $[Mn(CN)_6]^{3-}$ is 38500 cm^{-1}, then which of the following is incorrect?

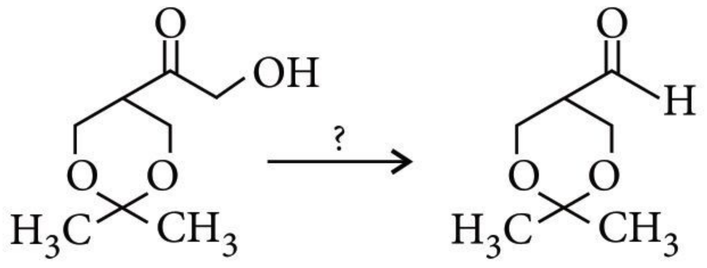
(a) Complex will be high spin complex.

(b) Complex will be low spin complex.

(c) Net CFSE = – 33600 cm^{-1}

(d) Magnetic moment of Mn^{3+} in the complex is 2.83 B.M.

12. The reagents employed to carry out the following transformation are



(a) $LiAlH_4$, H_2SO_4/heat

(b) PCC/CH_2Cl_2 followed by HIO_4

(c) $NaBH_4/CH_3OH$ followed by HIO_4

(d) O_3 followed by $(CH_3)_2S$

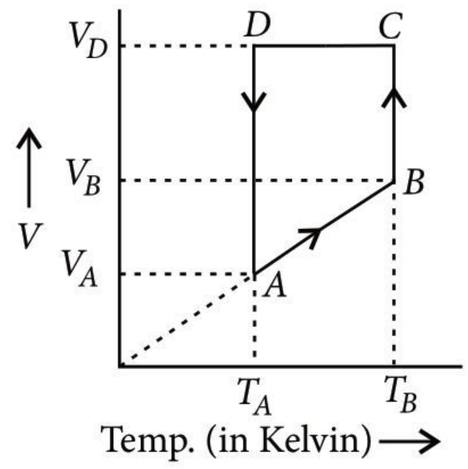
13. A gas mixture of 3 litres of propane and butane on complete combustion at 25°C produced 10 litres of CO_2, initial composition of the propane and butane in the gas mixture are respectively

(a) 66.67%, 33.33% (b) 33.33%, 66.67%

(c) 50%, 50% (d) 60%, 40%

14. Two moles of a monoatomic ideal gas are taken through a cyclic process starting from A as shown in figure. The volume ratios are $\frac{V_B}{V_A} = 2$ and $\frac{V_D}{V_A} = 4$.

If the temperature T_A at A is 27°C. Calculate the total heat absorbed (in calorie) in the cyclic process.



(a) 1080 (b) 900 (c) 600 (d) 1200

15. Aspartame is 160 times as sweet as sucrose and is used as a sugar substitute.

The correct statement about aspartame is

(I) it is an ester derivative of dipeptide

(II) it can be named as aspartyl phenylalanine methyl ester

(III) it is a tripeptide

(IV) It is less suitable for baking as it breaks down when heated and loses much of its sweetness.

(a) Only I (b) Only I, II, IV

(c) Only II, III, IV (d) Only II

16. Consider the following solutions :

(i) $C_6H_{12}O_6/H_2O$ (1 M)

(ii) $NaCl/H_2O$ (1 M)

(iii) C_6H_5COOH/C_6H_6 (1 M)

(iv) $(NH_4)_3PO_4/H_2O$ (1 M)

With respect to these solutions select the incorrect statement.

(a) All are isotonic solutions.

(b) (iii) is hypotonic of (ii) and (iv).

(c) (ii) and (iv) are hypertonic of (i).

(d) (iv) is hypertonic of (i), (ii) and (iii).

17. A G.M. counter is used to study the radioactive process of first order reaction. In the absence of radioactive substance A, it counts 3 disintegration per second (dps). When A is placed in the G.M. counter, it records 23 dps at the start and 13 dps after 10 min. It records x dps after next 10 min and A has half-life period of y min. x and y are

(a) 8 dps, 10 min (b) 5 dps, 10 min
(c) 5 dps, 20 min (d) 5 dps, 5 min.

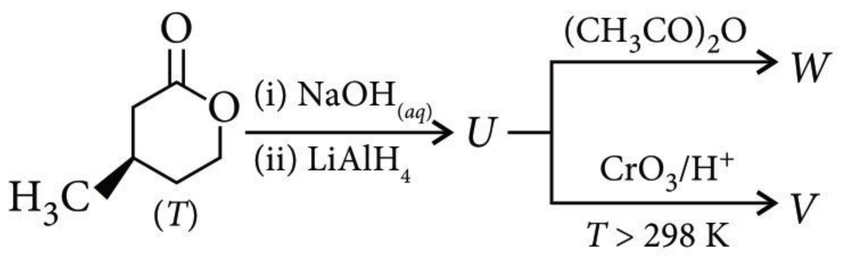
18. When 10 g anhydrous $CaCl_2$ were dissolved in water, 6.82 kJ enthalpy was evolved, while when 10 g of the crystal hydrate $CaCl_2 \cdot 6H_2O$ were dissolved in water, 0.87 kJ enthalpy was absorbed. Calculate the enthalpy of formation of the crystal hydrate from the anhydrous salt and water.

(a) –75.7 kJ/mol (b) 19.05 kJ/mol
(c) –94.75 kJ/mol (d) 94.75 kJ/mol

19. Among the following statements select the incorrect one?

(a) In the preparation of compounds of Xe, Bartlett had taken O_2PtF_6 as a base compound because both O_2 and Xe have almost same ionisation enthalpy.
(b) Nitrogen does not show allotropy.
(c) A brown ring is formed in the ring test for NO_3^- ion. It is due to the formation of $[Fe(H_2O)_5(NO)]^{2+}$.
(d) On heating with concentrated NaOH solution in an inert atmosphere of CO_2, red phosphorus gives PH_3 gas.

20. With reference to the scheme given, which of the given statement about T, U, V and W is incorrect?



(a) T is soluble in hot aqueous NaOH.
(b) U is optically active.
(c) Molecular formula of W is $C_{10}H_{18}O_4$.
(d) V gives effervescence on treatment with aqueous $NaHCO_3$.

21. Which of the following are correct on the basis of MOT?

(a) Bond strength order : $CO > CO^+$
(b) Bond length order : $O_2 > O_2^+ > O_2^-$
(c) Number of unpaired electrons order : $O_2 > NO > CO$
(d) Number of ABMO electrons order : $N_2^- > O_2 > Be_2$

22. Some reactions of two ores, A_1 and A_2 of the metal M are given below :

$[A_1] \xrightarrow{\text{Calcination}} \underset{\text{Black}}{[C]\downarrow} + CO_2 + H_2O$

$[A_1] \xrightarrow{KI/HCl} [D]\downarrow + I_2$

$[A_2] \xrightarrow{\text{Roasting}} [G]\uparrow + M$

$[G] + K_2Cr_2O_7 \xrightarrow{H^+}$ Green solution

Identify G.

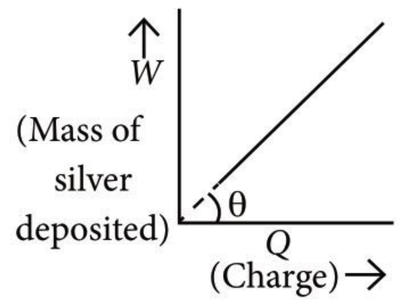
(a) SO_2 (b) CO_2 (d) SO_3 (d) O_2

23. Among the given statement. Select the correct one and choose the right option.

(I) The oxidation number of Cr in CrO_5 is +6.
(II) $\Delta H > \Delta U$ for the reaction, $N_2O_{4(g)} \rightarrow 2NO_{2(g)}$, provided both gases behave ideally.
(III) pH of 0.1 N H_2SO_4 is less than that of 0.1 N HCl at 25°C.
(IV) $\left(\frac{RT}{F}\right) = 0.0591$ volt at 25°C .

(a) (I) and (II) (b) (II) and (III)
(c) (III) and (I) (d) (III) and (IV)

24. In the electrolysis of silver nitrate, the mass of silver deposited is plotted against the charge (coulomb).



Slope of the line gives

(a) the equivalent mass of silver
(b) electrochemical equivalent of silver
(c) the value of faraday
(d) the current passed through the cell.

25. Which of the following are suspensions?

I. Milk of Magnesia II. Air
III. Orange Juice IV. Paint
V. Slaked lime for white washing

(a) Only I, II and III (b) Only III, IV and V
(c) Only I, III, IV and V (d) Only I, II and V

26. Match list-I with list-II and select the correct code :

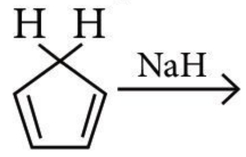
List-I (Periodic properties)	List-II (Order)
(P) Ionisation energy	(1) Sn < Pb
(Q) Atomic radii	(2) N < C < O
(R) Electronegativity	(3) Li < Be < B
(S) Electron affinity	(4) $O^- < S^-$

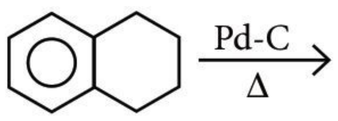
	P	Q	R	S
(a)	4	1	3	2
(b)	1	2	3	4
(c)	4	3	2	1
(d)	1	4	2	3

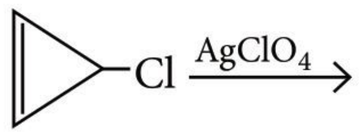
27. The pressure exerted by 12 g of an ideal gas at temperature t°C in a vessel of volume V litre is one atm. When the temperature is increased by 10 degrees at the same volume, the pressure increases by 10%. Calculate the temperature t and volume V. (Molecular weight of the gas = 120).

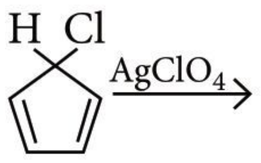
(a) 100 K and 0.82 L (b) 283 K and 0.82 L
(c) 173 K and 0.82 L (d) 100 K and 1.82 L

28. Which of the following reaction will not give an aromatic product?

(a) 

(b) 

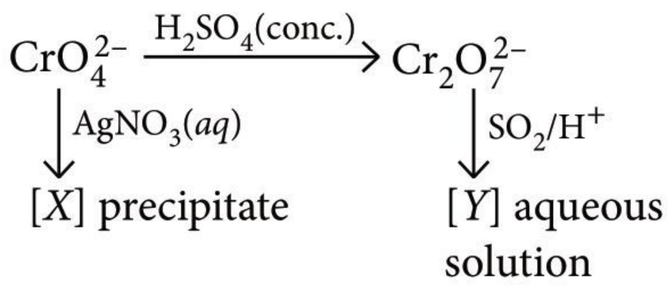
(c) 

(d) 

29. By estimating the difference in energy between 1st and 2nd Bohr orbit for a hydrogen atom, at what minimum atomic number, a transition from $n = 2$ to $n = 1$ energy level would result in the emission of X-rays with $\lambda = 3.0 \times 10^{-8}$ m?

(a) 4 (b) 2 (c) 3 (d) 1

30. Consider the reactions shown below :



Select the incorrect statement?

(a) [X] is a yellow coloured precipitate.
(b) [X] is soluble in ammonia solution.
(c) [Y] gives green coloured solution with excess of sodium hydroxide solution.
(d) The conversion of $Cr_2O_7^{2-}$ to [Y] is a redox reaction.

SOLUTIONS

1. (a) : Density = 8.55 g cm^{-3}, M_w of niobium = 93

For *bcc*, $Z = 2$

$\because$ Density $= \dfrac{Z \times M_w}{a^3 \times N_A}$

$\therefore \quad a^3 = \dfrac{2 \times 93}{8.55 \times 6.023 \times 10^{23}} = 3.6 \times 10^{-23}$ cm^3

or $a^3 = 36 \times 10^{-24}$ cm^3

$\therefore \quad a = 3.3 \times 10^{-8}$ cm

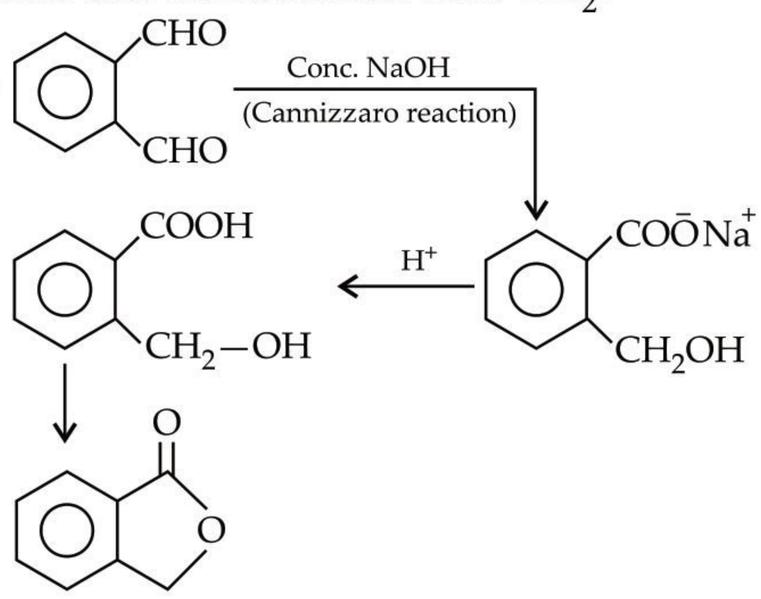
For *bcc*, $r = \dfrac{\sqrt{3}a}{4}$

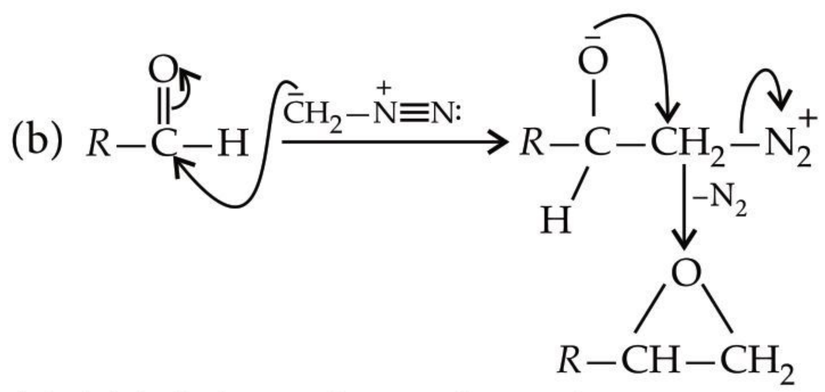
$\therefore \quad r = \dfrac{1.732 \times 3.3 \times 10^{-8}}{4} = 1.43 \times 10^{-8}$ cm

2. (c) : N_2O is linear as N = N = O

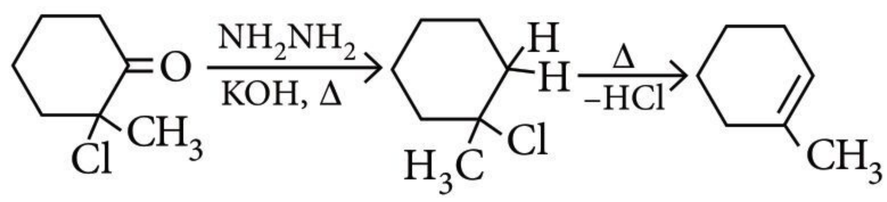
I_3^- is linear with 2 *bp* and 3 *lp*.

N_3^- is also linear and isoelectronic with CO_2.

3. (d) : (a) 

(b) 

(c) This is benzoin condensation.

(d) 

4. (c) : CH_3COOH + CH_3COONa

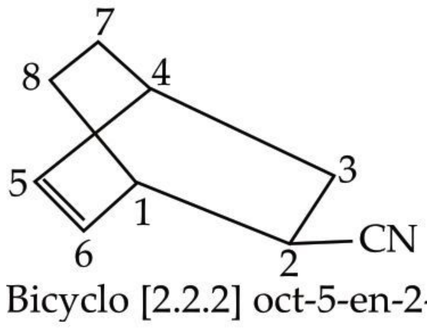
	0.1 N, 5 mL	0.05 N, 10 mL
milli eq.	0.5	0.5

It is acidic buffer, pH = $pK_a + \log \dfrac{[CH_3COO^-]}{[CH_3COOH]}$

pH = pK_a

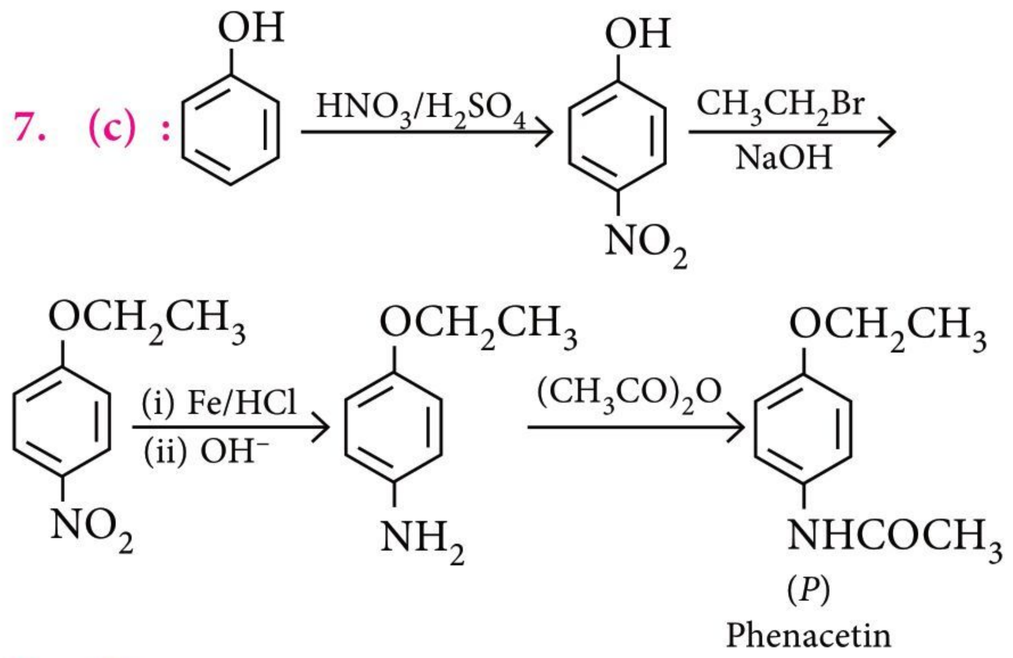
$\therefore$ This solution will have lowest pH.

5. (c) : Rate becomes 81 times by applying conditions given in option (c).

6. (b) : 

Bicyclo [2.2.2] oct-5-en-2-carbonitrile

7. (c) :



(*P*)
Phenacetin

8. (c) : As the molecular mass increases, boiling point increases.

9. (c) : At equilibrium both the solutions have same vapour pressure as well as same concentrations because both the solutes are non-electrolyte. Suppose *w* g water is transferred from dilute solution to concentrated solution, then

$C_1 = C_2$ or $\frac{w_1}{M_1V_1} = \frac{w_2}{M_2V_2}$ and,

volume of solvent ≈ volume of solution (for dilute solutions)

$$\therefore \quad \frac{20}{\frac{342\times(100+w)}{1000\times d}} = \frac{10}{\frac{342\times(100-w)}{1000\times d}}$$

(d = density of water)

$$\therefore \quad \frac{20}{100+w} = \frac{10}{100-w} \Rightarrow w = 33.3 \text{ g}$$

10. (a) : $K_a = \frac{C\alpha^2}{1-\alpha} \Rightarrow \frac{1}{6} = \frac{\alpha^2}{1-\alpha}$

$$\Rightarrow \quad \alpha = \frac{-1\pm\sqrt{(1)^2+4\times6\times1}}{12} = \frac{-1\pm\sqrt{1+24}}{12} = \frac{1}{3}$$

$$\therefore \quad [IO_3^-] = 1\times\frac{1}{3} = \frac{1}{3} \Rightarrow [Ag^+] = \frac{3\times10^{-8}}{1/3} = 9\times10^{-8} \text{ M}$$

Now, $2Ag + Zn^{2+} \xrightarrow{2e^-} 2Ag^+ + Zn$

$$E_{cell} = -1.56 + \frac{0.06}{2}\log\frac{1}{(9\times10^{-8})^2} = -1.1376 \text{ V}$$

11. (a) : $Mn^{3+} : t_{2g}^4\, e_g^0$

As CN^- is a strong field ligand, therefore complex will be of low spin.

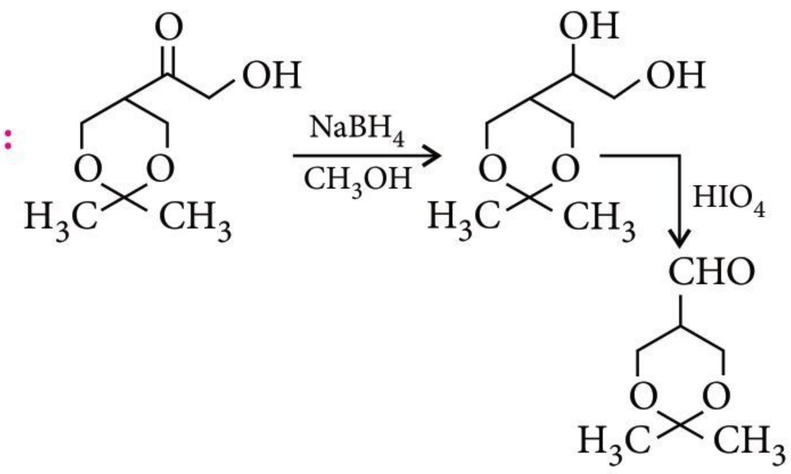
CFSE = $[-0.4(4) + 0.6(0)]\Delta_o + P$

= $-1.6\Delta_o + P = -1.6 \times 38500 + 28000 = -33600 \text{ cm}^{-1}$

No. of unpaired electrons in Mn^{3+} in $[Mn(CN)_6]^{3-}$ complex is 2.

Hence, $\mu = \sqrt{2(2+2)}$ B.M. = 2.83 B.M.

12. (c) :



13. (a) : Total vol. of $C_3H_8 + C_4H_{10}$ = 3 L

Let volume of C_3H_8 in the mixture = *a* L

Then, volume of C_4H_{10} = (3 – *a*) L

$$\underset{\substack{1 \text{ vol.}\\ a \text{ L}}}{C_3H_8} + 5O_2 \rightarrow \underset{\substack{3 \text{ vol.}\\ 3a \text{ L}}}{3CO_2} + 4H_2O$$

$$\underset{\substack{1 \text{ vol.}\\ (3-a) \text{ L}}}{C_4H_{10}} + \frac{13}{2}O_2 \rightarrow \underset{\substack{4 \text{ vol.}\\ 4(3-a) \text{ L}}}{4CO_2} + 5H_2O$$

Total vol. of CO_2 produced = $3a + 4(3 - a) = 10$

$\therefore \quad a = 2$ L

Hence, vol. of C_3H_8 = 2 L ; vol. of C_4H_{10} = 1 L

14. (d)

15. (b) :

Aspartame

16. (a)

17. (a) : There is an error of 3 dps

$\therefore \quad C_0 = 20$ dps

$C_t = 10$ dps

Thus, half-life = 10 min

In next 10 min C_t = 5 dps

$\therefore$ Recorded value with error = 8 dps

18. (c) : To dissolve anhydrous salt

$CaCl_{2(s)} + 6H_2O_{(l)} \rightarrow CaCl_2.6H_2O_{(s)} + \Delta H_1$

$CaCl_2.6H_2O_{(s)} + nH_2O_{(l)} \rightarrow CaCl_{2(aq)} - \Delta H_2$

ΔH_1 is the enthalpy of formation of the crystal hydrate and ΔH_2 is that of it's solution.

Now,

$CaCl_{2(s)} + (n + 6)H_2O_{(l)} \rightarrow CaCl_{2(aq)} + \Delta H_3$

Where ΔH_3 is the enthalpy of solution of the anhydrous salt.

Now, according to Hess's law, $\Delta H_3 = \Delta H_1 + \Delta H_2$

$\Rightarrow \quad \Delta H_1 = \Delta H_3 - \Delta H_2$

To find the required quantity (ΔH_1), we must consequently calculate the enthalpy of solution of the anhydrous salt (ΔH_3 and of the crystal hydrate ΔH_2)

The molar mass of $CaCl_2$ is 111 g/mol.

Since the change in the enthalpy when dissolving 10 g of $CaCl_2$ is 6.82 kJ.

Again, $\Delta H_3 = \frac{-6.82 \times 111}{10} = -75.7$ kJ/mol.

The molar mass of $CaCl_2.6H_2O$ is 219 g/mol.

Now,

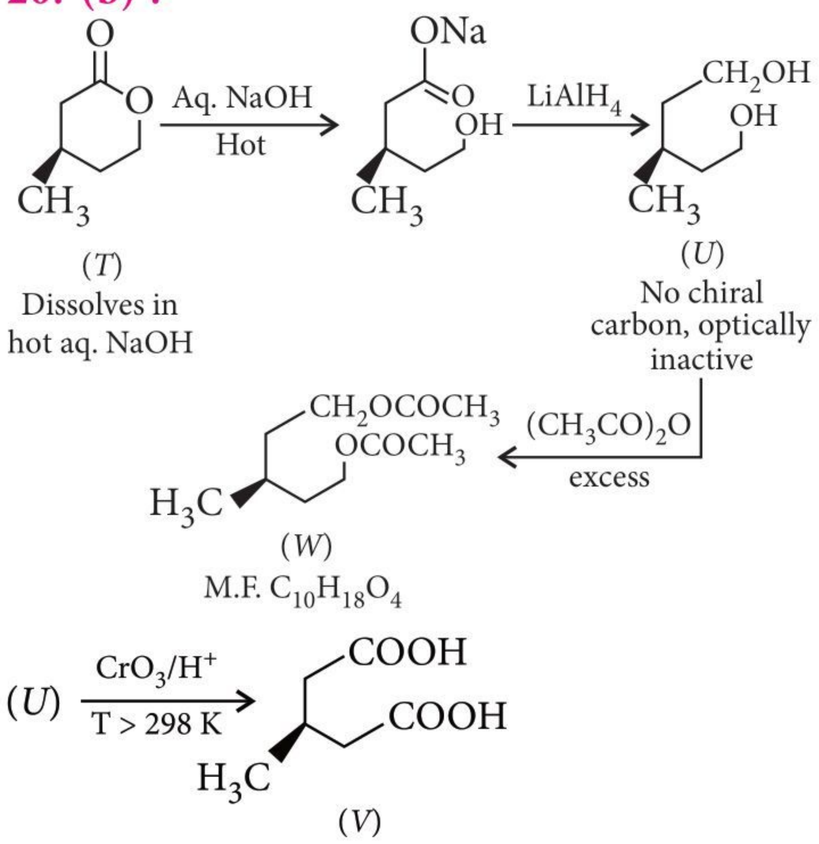
$$\Delta H_2 = \frac{0.87 \times 219}{10} = 19.05 \text{ kJ/mol.}$$

For the enthalpy of formation of the crystal hydrate, we finally get

$\Delta H_1 = \Delta H_3 - \Delta H_2 = -75.7 - 19.05 = -94.75$ kJ/mol

19. (d) : On heating with concentrated NaOH solution in an inert atmosphere of CO_2, white phosphorus gives PH_3 gas.

20. (b) :



V gives effervescence with $NaHCO_3$ due to evolution of CO_2.

21. (c) : Bond strength of CO < CO^+.

Bond length ∝ 1/bond order.

Unpaired electron : $O_2 = 2$, NO = 1 and CO = 0

Number of ABMO electrons : $O_2 = 6$, $N_2^- = 5$ and $Be_2 = 4$.

22. (a) : The formation of carbon dioxide when ore A_1 is calcined indicates that ore A_1 is a carbonate.

Since ore A_1 when treated with HCl and KI, evolves I_2 so, A_1 would be a hydroxide.

From these observation we get the possible formula of ore A_1 as $CuCO_3.Cu(OH)_2$. The reactions can be explained as follows :

$$\underset{A_1}{CuCO_3.Cu(OH)_2} \xrightarrow{\text{Calcination}} \underset{\text{(black)}\ C}{2CuO\downarrow} + CO_2\uparrow + H_2O$$

$$\underset{A_1}{CuCO_3.Cu(OH)_2} + 4HCl \rightarrow 2CuCl_2 + CO_2 + 3H_2O$$

$$2CuCl_2 + 4KI \rightarrow \underset{D}{Cu_2I_2}\downarrow + 4KCl + I_2\uparrow$$

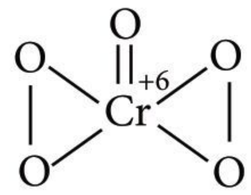
Ore A_2 when roasted gives gas G which gives green colour with acidified $K_2Cr_2O_7$ *i.e.* the gas G is SO_2. Since on roasting A_2 gives SO_2 so it should be a sulphide of copper.

$$\underset{A_2}{2Cu_2S} + 3O_2 \xrightarrow{\text{Roasting}} 2Cu_2O + \underset{G}{2SO_2}$$

$$Cu_2S + 2Cu_2O \xrightarrow{\text{Self reduction}} \underset{M}{6Cu} + SO_2$$

$$\underset{G}{3SO_2} + K_2Cr_2O_7 + H_2SO_4 \rightarrow K_2SO_4 + \underset{\text{(Green)}}{Cr_2(SO_4)_3} + H_2O$$

23. (a) : (I) Oxidation number of Cr in CrO_5 is +6.



(II) $N_2O_{4(g)} \rightarrow 2NO_{2(g)}$

$\Delta H = \Delta U + \Delta n_g RT$ ...(i)

$\Delta n_g = (2 - 1) = 1$

$\therefore$ From eq. (i), $\Delta H = \Delta U + RT$

$\therefore$ $\Delta H > \Delta U$.

(III) For 0.1 N H_2SO_4, $[H^+] = 0.1$ N

$\therefore$ pH = 1

For 0.1 N HCl, $[H^+] = 0.1$ N

$\therefore$ pH = 1

Therefore, (III) is incorrect.

(IV) $\frac{RT}{F} = \frac{8.314 \times 298}{96500} = 0.0256$ V

Therefore, (IV) is incorrect.

24. (b) : As $W = ZQ$

Comparing it with straight line eqn. *i.e.*, $y = mx + c$

$\therefore$ Slope = Z (Electrochemical equivalent).

25. (c) **26. (a)**

27. (a) : Number of moles of gas = $\frac{12}{120}$ = 0.1 mol

$P = 1$ atm, $T = (t + 273)$ K

$PV = nRT$

$1 \times V = 0.1 \times R \times (273 + t)$ ...(i)

Under new condition,

$1.1\ V = 0.1 \times R \times (273 + 10 + t)$

$1.1\ V = 0.1 \times R \times (283 + t)$ ...(ii)

Dividing (ii) by (i), we get,

$$\frac{1.1\ V}{1\ V} = \frac{0.1 \times R \times (283 + t)}{0.1 \times R \times (273 + t)} \Rightarrow 1.1 = \frac{283 + t}{273 + t}$$

$1.1\ t + 1.1 \times 273 = t + 283 \Rightarrow 0.1\ t = 283 - 300.3$

$t = -\frac{17.3}{0.1}$ or $-173°C \Rightarrow (-173 + 273) = 100$ K

Substituting this value of t in equation (i), we get

$1 \times V = 0.1 \times 0.082 \times (273 - 173)$

$V = 0.1 \times 0.082 \times 100 = 0.82$ L

28. (d) :  After removal of Cl-atom, The intermediate formed is anti-aromatic, so this reaction is not possible.

29. (b) : We know $E_n = -\frac{21.76 \times 10^{-19}}{n^2}$ J

$E_2 = -\frac{21.76 \times 10^{-19}}{4}$ J, and $E_1 = -21.76 \times 10^{-19}$ J

$\Delta E = E_2 - E_1 = 21.76 \times 10^{-19} \times 3/4$ J $= 16.32 \times 10^{-19}$ J

For hydrogen like species, $n_1 = 1$, $n_2 = 2$

$$E_2 = -\frac{21.76 \times 10^{-19} \times Z^2}{n^2} = -\frac{21.756 \times 10^{-19} \times Z^2}{4} \text{J}$$

$$E_1 = -\frac{21.76 \times 10^{-19} \times Z^2}{n^2} = -\frac{21.76 \times 10^{-19} \times Z^2}{1} \text{J}$$

$$\Delta E = E_2 - E_1 = 21.76 \times 10^{-19}\left(1 - \frac{1}{4}\right) Z^2 \text{J}$$

$= 21.76 \times 10^{-19} \times 3/4 \times Z^2$ J $= 16.32 \times 10^{-19}\ Z^2$ J

Using the relation, $\Delta E = \frac{hc}{\lambda}$, we get

$$16.32 \times 10^{-19}\ Z^2 = \frac{6.626 \times 10^{-34} \times 3 \times 10^8}{3.0 \times 10^{-8}}$$

or $Z^2 = \frac{6.626 \times 10^{-34} \times 10^{16}}{16.32 \times 10^{-19}}$ or $Z^2 = 4$ or $Z = 2$

Therefore, atomic number of species is 2 *i.e.* it is He^+.

30. (a) : $Ag^+ + CrO_4^{2-} \longrightarrow \underset{(X)\text{ red ppt.}}{Ag_2CrO_4}\downarrow$

$Ag_2CrO_4\downarrow + 4NH_3 \longrightarrow 2[Ag(NH_3)_2]^+ + CrO_4^{2-}$

$3\overset{+4}{S}O_2 + \overset{+6}{Cr}_2O_7^{2-} + 2H^+ \longrightarrow \underset{(Y)}{2Cr^{3+}} + 3\overset{+6}{S}O_4^{2-} + 3H_2O$

$\underset{(Y)}{Cr^{3+}} + 3OH^- \longrightarrow \underset{\text{(green)}}{Cr(OH)_3}\downarrow$

$Cr(OH)_3 + OH^- \longrightarrow [Cr(OH)_4]^-$

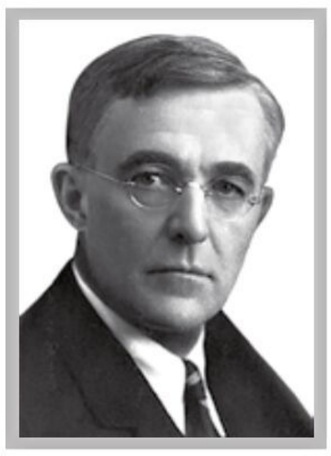
(green coloured soluble complex)

Scientist of the Month

Irving Langmuir

Early Life and Education

- Irving Langmuir was born in Brooklyn, New York, on January 31, 1881. He was the third of the four children of Charles Langmuir and Sadie, née Comings. Langmuir attended several schools and institutes in America and Paris (1892–1895) before graduating high school from Chestnut Hill Academy (1898), an elite private school located in the affluent Chestnut Hill area in Philadelphia. He graduated with a Bachelor of Science degree in metallurgical engineering (Met.E.) from the Columbia University School of Mines in 1903. He earned his PhD in 1906 under Friedrich Dolezalek in Göttingen, for research done using the "Nernst glower", an electric lamp invented by Nernst.



Irving Langmuir
(31 January 1881 - 16 August 1957)

Research

- His initial contributions to science came from his study of light bulbs (a continuation of his PhD work). His first major development was the improvement of the diffusion pump, which ultimately led to the invention of the high-vacuum rectifier and amplifier tubes.
- As he continued to study filaments in vacuum and different gas environments, he began to study the emission of charged particles from hot filaments (thermionic emission). He was one of the first scientists to work with plasmas, and he was the first to call these ionized gases by that name because they reminded him of blood plasma.
- He introduced the concept of electron temperature and in 1924 invented the diagnostic method for measuring both temperature and density with an electrostatic probe, now called as Langmuir probe and commonly used in plasma physics.
- In 1917, he published a paper on the chemistry of oil films that later became the basis for the award of the 1932 Nobel Prize in chemistry.

Honors

- Fellow of the American Academy of Arts and Sciences (1918)
- Perkin Medal (1928)
- Nobel Prize in Chemistry (1932)
- Franklin Medal (1934)
- Faraday Medal (1944)
- John J. Carty Award of the National Academy of Sciences (1950)
- Mount Langmuir (elevation 8022 ft / 2445 m) in Alaska is named after him (Chugach National Forest, Copper River, AK)
- Langmuir College, a residential college at Stony Brook University in H-Quad, named for him in 1970

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